

بلد الاول
لد الاول
ر ١٩٧٧



معهد التراث العلمي العربي
جامعة حلب ـ سورية

٢٩٥





السنة الأولى — العدد الأول — أيار ١٩٧٧

محتويات العدد

الابحاث العربية

الأبحاث الاجنبية

مجلة تاريخ العلوم العربية

تصدر مجلة تاريخ العلوم العربية عن معهد التراث العلمي العـربي مرتين كل عام (في فصلي الربيـع والخريف) . يرجى ارسال نسختين من كل بحث أو مقـال الى : **معهد التراث العلمي العربي ـ جامعة حلب .**

توجه كافة المراسلات الخاصة بالاشتراكات والاعلانات والأمـور الادارية الى العنوان نفسه .

قيمة الاشتراك السنوي :

بالبريد العادي	٢٥ ليرة سورية أو ٦ دولارات أميركية
بالبريد الجوي	٤٢ ليرة سورية أو ١٠ دولارات أميركية

قيمة العدد الواحد :

بالبريد العادي	١٥ ليرة سورية أو ٤ دولارات أميركية
بالبريد الجوي	٢٥ ليرة سورية أو ٦ دولارات أميركية

افتتاحية العدد الأول

الدكتور احمد يوسف الحسن

هذه مجلة عالمية تظهر الى الوجود مع صدور هذا العدد ، إنها مجلة الأسرة العالمية للباحثين المهتمين بتاريخ العلوم العربيـــة ـ الاسلامية . وبصدور هذه المجلة يجد هؤلاء الباحثون في الشرق والغرب لأنفسهم مكاناً يلتقون فيه وينشرون فيه نتاج عملهم الدؤوب في الكشف عـــن التراث العلمي في الحضارة العربية الاسلاميـــة .

وهذه المجلة تصدر تنفيذاً للتوصيات والمقررات الـــتي اتخذتها الندوة العالمية الأولى لتاريخ العلوم عند العرب المنعقدة في جامعة حلب بين ٥ و ١٢ ابريل (نيسان) ١٩٧٦ . لقـــد حققت الندوة المذكورة نجاحاً كبيراً ووجد فيهـــا مؤرخو العلوم العربية الاسلامية فرصة عظيمة للتعارف ولتوحيد الجهود . وكان أن اتخذوا عـــدة مقررات هامة ، منها أن تستمر الندوة العالميـــة لتاريخ العلوم عند العرب في الانعقاد بصورة دورية مرة كل ثلاث سنوات ، ومنها التوصية بصدور مجلة عالمية لتاريـــخ العلـــوم عند العرب تكون لسانهم الناطق . وقد أسند المؤتمرون الى معهد التراث العلمي العربي مهمة تنفيذ هـــذه التوصيات . وبذلك أنيطت بهـــذا المعهد منذ تأسيسه مهمة تنسيق وتوحيد جهود مؤرخي العلوم العربية الاسلامية عـــن طريق عقد الندوة العالمية بصورة مستمرة وعـــن طريق إصدار مجلة تاريخ العلوم العربية .

ان افتتاحية هـــذا العدد التي حررها الدكتور سامي حمارنة باللغة الانكليزية تحتوي عـلى شرح واف لأهداف المجلة . ويدافع الدكتور حمارنة عن استخدام تعبير «العلوم العربية» أو «العلوم العربية الاسلامية» . وسواء أكان القارئ من أنصار هذا التعبير أم ذالك فنحن نؤكد أننا لا نقصد التمييز بـــين حضارة عربية وأخرى اسلاميـــة ، فالمجلة معنية بالحضارة الاسلامية أو بالحضارة العربية أو بالحضارة العربية الاسلامية . وانما استخدمنا تعبير العلوم العربية لمـــا للعربية وهي لغة القرآن الكريم من فضل ومن مكانة ، فهي لغة الحضارة الاسلامية بشكل عام وبهـــا كتبت معظم مخطوطات تراثنا العلمي .

وقد اختارت المجلة اللغات العربية والانكليزية والفرنسية لكي ينشر بها الباحثون مقالاتهم . ونلاحظ من محتويات هذا العدد أن معظم الباحثين قد نشروا أبحاثهم باللغة الانكليزية . وهذا بديهي في هذه المرحلة المبكرة من اهتمام الجامعات العربية والاسلامية بدراسة تاريخ العلوم العربية الاسلامية . اذ لا يزال مركز الثقل في أبحاث التراث العلمي العربي الاسلامي موجوداً في الجامعات غير العربية وغير الاسلامية . والمرجو أن تثير هذه المجلة اهتمام الجامعات العربية والاسلامية حتى نرى في المستقبل مزيداً من الابحاث الجادة الصادرة عن هذه الجامعات .

انني أشكر هذه الأسرة العالمية من المحررين الاستشاريين ، وكلهم من كبار رجال العلم الذين برزوا في أبحاثهم على الصعيد العالمي ، على تعاونهم وعلى حماستهم لانجاح هذه المجلة وعلى تطوعهم دون أي مقابل لتحريرها وامدادها بالمقالات والابحاث .

معهد التراث العلمي العربي
جامعة حلب

الدكتور احمد يوسف الحسن

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مقالة الحسن بن الحسن بن الهيثم في الأثر الظاهر في وجه القمر

تحقيق الدكتور

عبد الحميد صبرة

استاذ تاريخ العلوم
عند العرب في جامعة هارفارد

المقدمـــة :

المقالة التي ننشر نصها فيما يلي ذكرها ابن أبي أصيبعة في كتابه «عيون الأنباء في طبقات الأطباء» ضمن «القائمة الثالثة» التي أوردها لمصنفات ابن الهيثم ، وترتيب المقالة في هذه القائمة هي التاسعة والأربعون (أنظر مقالنا عن ابن الهيثم في «قاموس الأعلام العلميـــة» Dictionary of Scientific Biography ، الجزء السادس ، نيويورك ، سنة ١٩٧٢) . كذلك جاء ذكر المقالة في «أخبار الحكماء» لابن القفطي (المصنف رقم ٦٧) — أنظر نشرة ليبرت ، ليبتسك ١٩٠٣ ، ص ١٦٨ . وفيما نعلم لا يوجد لمقالة ابن الهيثم سوى نسخة واحدة محفوظة في مكتبة بلدية الإسكندرية تحت رقم ٢٠٩٦ د ، وأوراقه مرقومة ٤٧—٥٤ . ونص هذه المقالة لم يسبق نشره محققاً ، إلا أنه ترجم إلى اللغة الألمانية بقلم المستشرق الباحث في تاريخ الرياضيات العربية كارل شوي وظهرت هذه الترجمة في هانوفر سنة ١٩٢٥ ، كما نشر أرمان آبل بحثاً عن المقالة بالفرنسية سنة ١٩٣٥ — أنظـــر :

Carl Shoy, *Abhandlung des Shaichs... Ibn al-Haitham: Über die Natur der Spuren (Flecken), die man auf der Oberfl.:che des Mondes sieht...,* Hannover, 1925.

Arman Abel, La sélénographie d'Ibn Al-Haitham (965-1039) dans ses rapports avec la science grecque. *Comptes rendus* [*du*] *II*e *Congrès National des Sciences, Bruxelles,* 19-23 *Juin* 1935, pp. 76-81.

عنوان المقالة كما جاء في مخطوط الإسكندرية «مقالة الشيخ أبي علي الحسن بن الحسن بن الهيثم رحمه الله في مائية [= ماهية] الأثر الذي في وجه القمر» . والمخطوط مجلد قائم بذاته له رقمه الخاص به . ولكن يتضح من ترقيم صفحاته ومقارنة خطه بخط مقالين آخرين في مكتبة الإسكندرية (وكلها بخط نسخي واحد واضح ودقيق) ان هذه المقالات الثلاثة على الأقل كانت مؤلفة في مجلد واحد قبل الفصل بينها في مجلدات ثلاثة . ولم يبين تاريخ نسخ هذه المقالات في واحدة منها . أما المقالان الآخران فهما :

(أ) «مقالة تتضمن شكوك ابن الهيثم على بطلميوس» ، ورقمها ٢٠٥٧ د. وترقيم أوراقها ، كما يبدو من الرقم الوحيد المبين في وجه الورقة ١٢ ، هو ١–١٨ . (وقد نشرت مطبعة دار الكتب بالقاهرة نص هذه المقالة سنة ١٩٧١ مراجعاً على نسخة أخرى في أكسفورد بتحقيق عبدالحميد صبره ونبيل الشهابي) .

(ب) «مقالة ابن الهيثم في كيفية الرصد»، ورقمها ٣٦٨٨ ج . وترقيم أوراقها٣١-٤٦.

ولما كان «ترقيم الأوراق في مقالة «الأثر» يبدأ بالرقم ٤٧ فمن الواضح أن ترتيب هذه المقالة كان تالياً مباشرة لمقالة «كيفية الرصد» في المجلد الجامع الأصلي ، وأن ذلك المجلد كان يتصدره مقالة «الشكوك» . أما الفجوة بين الورقة الأخيرة في مقالة «الشكوك» (ورقم هذه الورقة ١٨) والورقة الأولى في مقالة «كيفية الرصد» (ورقمها ٣١) فلا بد أنه كان يشغلها مقالة أخرى يرجح أن تكون هي الأخرى لابن الهيثم . وبالفعل ذكر بروكلمان في «تاريخ الأدب العربي» لابن الهيثم مقالة في مكتبة الإسكندرية بعنوان «التنبيه على مواضع الغلط في كيفية الرصد» ربما كانت هي المتممة لذلك المجلد الجامع الأصلي ، ولكني لم أطلع بعد على هذه المقالة للبت في هذا الغرض .

يشير ابن الهيثم في مقالة «الأثر» إلى اثنتين من مقالاته ، هما مقالته «في ضوء القمر» (رقم ٦ في قائمة ابن أبي أصيبعة الثالثة) ومقالته «في أضواء الكواكب» (رقم ٣/٤٨)، كما يشير إلى كتابه الكبير المحتوي على سبع مقالات «في المناظر» (رقم ٣/٣) . وقد حفظت لنا هذه المصنفات الثلاثة في نسخ خطية ، وطبع منها مقالة «ضوء القمر» ومقالة «أضواء الكواكب» ضمن «مجموع رسائل ابن الهيثم» التي نشرتها دائرة المعارف العثمانية في حيدر آباد سنة ١٣٥٧ هجرية . والأولى من هاتين المقالتين ترجمت الى الألمانية بقلم كارل كول سنة ١٩٢٤ ، والثانية ترجمها إلى الإنجليزية وليد عرفات و ج. ج. ونتر سنة ١٩٧١ (أنظر بيانات هذه الترجمات في مقالنا المذكور سابقاً عن ابن الهيثم) . وإذن فمقالة «الأثر» هي من أعمال ابن الهيثم المتأخرة الناضجة التي دونها بعد اكتمال آرائه في إشراق الأضواء وبخاصة كما أوضحها في «ضوء القمر» وفي «البصريات» . وابن الهيثم في مواضع متعددة من مقالة «الأثر» يتناول بعض آرائه في المصنفين السابقين بشيء من التفصيل ويضيف اليها ما يزيدها تحديداً ، هذا فضلا عن محاولته تطبيق هذه الآراء لتفسير «الأثر» بافتراض زيادة «كثافة» الموضع الذي يظهر فيه عن سائر المواضع في سطح القمر .

لم نتناول النص بشيء من التغيير عدا تقسيمه الى فقرات وإضافة علامات الوقف ، مع الاقتصاد في هذه الإضافة ، والهمزات وبعض الشكل لإزالة ما قد يعرض من إبهام . ويجد القارىء في جهاز التحقيق في آخر النص دليلاً شاملاً لكل ما أدخلنا من تعديلات أو جئنا به من اقتراحات في قراءته ، ويتبين من هذا الجهاز أن مخطوط الإسكندرية الوحيد قد احتفظ لنا لحسن الحظ بنسخة جيدة خالية من الفجوات أو الصعوبات التي يعسر حلها .

[٤٧ و]

مقالة الشيخ أبي علي الحسن بن الحسن بن الهيثم رحمه الله في مائية الأثر الذي في وجه القمر

[٤٧ ظ]

بسم الله الرحمن الرحيم

قال أبو علي الحسن بن الحسن بن الهيثم :

قد اختلف أهل النظر في مائية الأثر الذي يظهر في وجه القمر . وهذا الأثر إذا تؤمل واعتبر وجد دائماً على صفة واحدة لا يتغير لا في شكله ولا في وضعه ولا في مقداره ولا في كيفية سواده . وقد تصرفت ظنون الناس فيه وتشتتت آراؤهم ، فرأى قوم أنه في نفس جرم القمر ، ورأى قوم أنه خارج عن جرم القمر ومتوسط بين جرم القمر وبين أبصار الناظرين اليه ، ورأى قوم أنه صورة تظهر بالانعكاس لأن سطح القمر صقيل فاذا نظر اليه الناظر انعكس شعاع بصره عن سطح القمر إلى الأرض كما ينعكس عن سطوح المرايا فيظهر له صورة الأرض أو بعضها ، وقال قوم إنه صورة البحار التي في الأرض ترى بالانعكاس ، وقال قوم إنه صورة الجبال التي في الأرض ، وقال قوم إنه صورة قطعة من الأرض التي يقع عليها الشعاع المنعكس .

فأما من قال إن الأثر هو شيء متوسط(١) بين البصر وبين جرم القمر فيعتقد أن القمر يجتذب من الأرض بخاراً ما (٢) بخاصية فيه فيرتقي البخار وينعقد ويكون أبداً تحت القمر ويكون أبداً على صفة واحدة فلذلك لا يتغير شكله ولا مقداره ولا وضعه من القمر .

فأما من قال إنه في نفس جرم القمر فانهم اختلفوا : فقالت طائفة منهم إنه شفيف يسير في جسم القمر ، فاذا نظر الناظر اليه رأى ما وراءه فيمتزج صورة الضوء الذي في موضع الشفيف بصورة السماء التي من وراء القمر فيظهر مخالفاً للّون الذي في بقية جرم القمر . وقال قوم هو خشونة في الموضع ، وجرم القمر صقيل ، فاذا أشرق عليه ضوء الشمس لم يقبل الموضع الخشن الضوء كما يقبله الصقيل . ويمكن أن يقال إن موضع الأثر خشونة بارزة وأجزاؤها شاخصة ، وإذا أشرقت عليها الشمس صارت لأجزاء الخشونة أظلال على ما يليها من سطح القمر فيظلم موضع الظل ، والأثر الذي في القمر هو أظلال أشخاص الخشونة . ويمكن أن يقال إن في جسم القمر تقعيراً ، فاذا أشرق عليه ضوء الشمس صار لمحيط التقعير ظل على

باطن التقعير ، والأثر هو ظل محيط التقعير . ويمكن أن يقال إن في السماء موضعاً أو مواضع فيها بعض الكثافة كما أن المجرة فيها بعض الكثافة ، إلا أن في المجرة ضوءاً مّا وليس في تلك المواضع ضوء ولذلك ليس يظهر ، وأن موضعاً من تلك المواضع متوسط بين الشمس والقمر ، فاذا أشرق ضوء الشمس على القمر كان لذلك الموضع ظل على سطح القمر ، والأثر هو ظل الموضع الكثيف من السماء .

وجميع هذه الآراء تبطل [٤٨ و] وتضمحل عند تحقيق النظر . ونحن نبين فساد جميع هذه الآراء ، ثم نبين بعد ذلك مائية هذا الأثر .

أما رأي من رأى أن الأثر خارج عن جرم القمر ، وأنه بخار يجتذبه القمر من الأرض ، وأنه متوسط بين البصر وبين جرم القمر ، فانه ظاهر الفساد . وذلك أنه لو كان الأمر كذلك لكان يختلف موضع الأثر من سطح القمر عند المواضع المختلفة من الأرض في وقت واحد ، لأن كل جسم متوسط بين البصر والمبصر فان له اختلاف منظر . وليس يوجد الأمر كذلك ، بل يوجد الأثر[٣] إذا نظر إليه في الليلة من أول الليل إلى آخره من المواضع المختلفة من الأرض رؤي في موضع واحد بعينه من سطح القمر . فلو كان الجسم المتوسط في نفس جسم السماء أيضاً لا في الهواء ، بعد أن يكون بينه وبين القمر بُعد مّا ، لم يكن بد من أن يتغير موضعه من سطح القمر في الرؤية إذا نظر إليه من موضعين مختلفين من الأرض ، وخاصة إن كان البعد الذي بين الموضعين بعداً متفاوتاً . فأما إذا كان المتوسط في الهواء ونظر إليه في وقت واحد من موضعين من الأرض يكون البعد الذي بينهما متفاوتاً ، وأدرك الأثر من أحد الموضعين في وسط سطح القمر ، فانه من الموضع الآخر يرى خارجاً عن جرم القمر ولا يرى في القمر شيء من الأثر ، لأن الجسم المتوسط بين البصر والمبصر كلما كان أبعد عن المبصر كان اختلاف منظره أكثر .

وأيضاً فانه إذا كان الأثر بخاراً يجتذبه القمر ، وكان وضعه أبداً من القمر وضعاً واحداً ، فانه إذا كان القمر قريباً من الأفق ونظر الناظر إليه فليس يكون ذلك البخار متوسطاً بين بصر الناظر وبين القمر . وإن كان متوسطاً بين بصره وبين القمر فليس يكون موضعه من القمر هو موضعه الذي كان يراه ذلك الناظر في وقت كون القمر في وسط السماء أو قريباً من الوسط من أجل اختلاف المنظر . فليس الأثر الذي في القمر بشيء متوسط بينه وبين القمر .

فأما رأي من رأى أنه صورة تظهر بالانعكاس فانه يبطل بما نذكره : وهو أن الانعكاس يكون على زوايا متساوية تحدث بين خطوط الشعاع وبين السطح الصقيل . وإذا كان ذلك كذلك فان القمر إذا اختلف وضعه من البصر اختلفت زوايا الانعكاس التي تحدث بين خطوط الشعاع الخارجة من البصر وبين سطحه . وكلما بعد القمر من وسط السماء اتسعت الزوايا التي تحدث بين الخطوط الأول التي تخرج من النظر إلى القمر وبين الخطوط المنعكسة عنها ، وإذا اتسعت هذه الزوايا تغيرت المواضع التي ينتهي إليها الشعاع المنعكس ، فان كانت

هذه الشعاعات تنتهي إلى سطح الأرض فانما تنتهي إلى [٤٨ ظ] مواضع مختلفة من الأرض، وإذا كانت الشعاعات تنتهي إلى مواضع مختلفة من الأرض، وكان الأثر إنما هو صورة البخار وصورة الجبال، فقد كان يجب أن يختلف شكل الأثر لأن أشكال الجبال وأشكال محيطات البحار في المواضع المختلفة من الأرض مختلفة، وليس يوجد شكل الأثر في الأوقات المختلفة مختلفاً، وقد كان يلزم أن يعرض هذا الاختلاف في الليلة الواحدة عند البصر الواحد، لأنه كلما بعد القمر من سمت الرأس تغيرت أوضاع الشعاعات الخارجة إليه(٤) من البصر واتسعت الزوايا التي بين الشعاعات الأول وبين الشعاعات المنعكسة.

وأيضاً فانه إذا قرب القمر من أفق المغرب، أو كان قريباً من أفق المشرق، فان الشعاعات التي كانت تنعكس إلى الأرض تصير خارجة عن الأرض. لأنه إذا كان القمر قريباً من الأفق تكون الشعاعات الخارجة إليه من البصر مائلة جداً عن سطحه، فتكون الشعاعات المنعكسة عنها مائلة أيضاً عن سطحه شديدة الميل، ويكون ميل الشعاعات المنعكسة الى ضد الجهة التي فيها الأرض فيلزم من ذلك ألا تقع الشعاعات على سطح الأرض، فيلزم من ذلك أن يكون القمر إذا كان قريباً من الأفق أي جهة كان من جهات الأفق لا يظهر(٥) فيه شيء من الأثر إن كان الأثر هو صورة الأرض أو البحار(٦) أو الجبال أو شيء من الأرض يظهر بالانعكاس. وليس يوجد الأمر كذلك، بل يوجد الأثر الذي في القمر أبداً في القمر في موضع بعينه من سطح القمر كان القمر في الأفق أو في وسط السماء أو فيما بين ذلك.

وأيضاً فانه إذا كان القمر على سمت الرأس، وكثيراً ما يعرض ذلك في المواضع التي عرضها أقل من المجتمع من غاية ميل الشمس مع غاية عرض القمر، فان شعاع البصر الذي يخرج إلى وسط سطح القمر يكون عموداً على سطح القمر فينعكس على نفسه فيرجع إلى البصر ولا يدرك به شيء من سطح الأرض، وتكون الشعاعات الخارجة إلى بقية سطح القمر ينعكس أكثرها إلى مواضع خارجة عن الأرض، وهي الشعاعات التي تنعكس من محيط القمر من المواضع البعيدة عن وسطه. والتي تنعكس إلى الأرض إنما تنعكس من وسط سطح القمر ومن حوالي القمر، فتكون الصورة التي تظهر إنما تظهر في وسط سطح القمر فقط. فلو كان الأثر الذي يرى في القمر هو صورة تظهر بالانعكاس لقد كان يجب أن ترى الصورة في وقت كون القمر على سمت الرأس في وسط سطح القمر فقط. وليس يوجد الأمر كذلك، أعني أنه ليس يوجد الأثر في وقت من الأوقات في وسط سطح القمر فقط، فليس الأثر الذي في القمر صورة تظهر بالانعكاس.

وأما رأي من رأى أن الأثر في نفس جرم القمر، وأنه [٤٩ و] شفيف يسير في جرم القمر، فانه ينتقض بكسوف الشمس. وذلك أن كسوف الشمس إنما هو بتوسط القمر بين الأرض وبين جرم الشمس فتستتر الشمس بالقمر، فان استتر جميعها انكسف جميعها، وإن استتر بعضها انكسف ذلك البعض. وهذا المعنى يظهر بالحس ظهوراً بيناً، لأنه إذا انكسفت الشمس ونظر

إليها ناظر فانه يجد جرم القمر في وجه الشمس . ومتى اعتبر ذلك وجد على ما ذكرنا . فان لم يستطع الناظر النظر إلى الشمس ، فانه إذا وضع طستاً في موضع منكسف الشمس وسكب فيه ماءً صافياً وصبر إلى أن يسكن الماء ، ثم نظر في الماء ، فانه يرى القمر بالانعكاس ويجده في وجه الشمس . ولأن كسوف الشمس إنما هو بالقمر صار المقدار المنكسف من الشمس يختلف عند المواضع المختلفة من الأرض من أجل اختلاف منظر القمر لأنه متوسط بين القمر وبين جرم الشمس . فلو كان الأثر الذي في القمر هو شفيف في جسم القمر لكان ما يكسف الشمس ، ولكان ضوء الشمس يظهر من وراء نور القمر في وقت الكسوف . وإذا لم يظهر ظهوراً بيناً فانه قد كان يظهر شفيف القمر إذا كان في وجه الشمس وإن كان شفيفه يسيراً . لأن كل مشف فانه يظهر ما وراءه مضيئاً ، وإذا (٧) كان شفيفه يسيراً فانه يظهر شفيفه إذا كان وراءه جسم مضيء ، وما لا يظهر ما وراءه(٨) ولا يظهر شفيفه إذا كان وراءه جسم مضيء فليس بمشف . فليس الأثر الذي في القمر بشفيف هو في جسم القمر .

وأما رأي من رأى أن الأثر هو خشونة في موضع الأثر من سطح جرم القمر ، وبقية سطح جرم القمر صقيل ، فان القمر يقبل الضوء من الشمس ، فالمواضع الصقيلة تقبل الضوء أكثر من قبول المواضع الخشنة ، فان هذا الرأي ينتقض بما بيناه في كتابنا في ضوء القمر. وذلك أنه قد تبين في ذلك الكتاب أن القمر إذا أشرقت عليه الشمس صارت ذاته مضيئة وصار الضوء الذي يشرق منه إنما يشرق كما يشرق الأضواء . فالأجسام المضيئة من ذواتها ليس يشرق الضوء منها من أجل صقالها ولا من أجل سطوحها فقط ، بل إنما يشرق الضوء من كل جزء منها ، وليس إضاءتها من أجل صقالها بل من أجل القوة النورية التي هي فيها . وهذا المعنى يظهر مثله في النار وفي أجزائها وفي أجزاء الأجسام الحاملة للنار . وأيضاً فان الخشونة تمنع انعكاس الضوء عنها لا قبول الضوء . ومع ذلك فان الخشونة أولى بقبول الضوء من الصقال ، لأن الضوء إذا أشرق [٤٩ ظ] على الجسم الخشن دخل في مسامه وغضونه ، والصقال يمنع الجسم الصقيل من قبول الضوء . والدليل على ذلك انعكاس الضوء عن الجسم الصقيل . فلو كان الصقيل(٩) أشد قبولاً من الجسم الخشن لما كان ينعكس الضوء عنه ويرجع عند مصادمته . فليست الخشونة علة مانعة لقبول الضوء وإنما هي مانعة لانعكاس الضوء . فلو كان الضوء الذي يظهر في سطح القمر إنما هو بالانعكاس . لقد كان يمكن أن يقال إن موضع الأثر إنما هو خشونة في سطح القمر تمنع من انعكاس الضوء ، وبقية سطح القمر صقيل ، فالضوء ينعكس عنه ، فلذلك (١٠) صار موضع الأثر ناقص الضوء . إلا أنه قد تبين في كتابنا في ضوء القمر معما قدمنا ذكره أن الضوء الذي يشرق من القمر والضوء الذي يدركه البصر في سطح القمر ليس شيء منه بالانعكاس . فليس يصح أن يكون نقصان الضوء في موضع الأثر من أجل خشونة في موضع الأثر .

فان قيل إن الذي يشهد به الوجود هو أن الأجسام الصقيلة إذا أشرق عليها الضوء كان الضوء الذي يظهر في سطحها قوياً ساطعاً أقوى من الضوء الذي يظهر في سطوح الأجسام

١٠

الخشنة ، وفي ذلك دليل على أن الأجسام الصقيلة تقبل الضوء قبولاً أكثر من قبول الأجسام الخشنة ، فنقول في جواب هذا القول إن القوة القابلة للضوء هي غير الضوء الذي يتأدى إلى البصر وإنما هي القوة التي تثبت الضوء في الجسم الذي يشرق عليه الضوء . والضوء الذي يتأدى إلى البصر من الأجسام التي يشرق عليها الضوء يكون على وجهين ، أحدهما بالانعكاس والآخر هو أن في طبيعة (١١) الضوء ومن خاصية الضوء إذا حصل في جسم كثيف أن يشرق من كل نقطة منه إلى كل نقطة تقابله . وقد شرحنا هذا المعنى شرحاً مستقصى في كتابنا في المناظر . والضوء الذي يشرق من كل نقطة من الضوء هو الذي نسميه ضوءاً ثانياً . والضوء الذي ينعكس على الأجسام الصقيلة هو الضوء الأول بعينه والثاني معاً : أما الأول فان الصقيل يدافعه ويعكسه إلى البصر ، وأما الضوء الثاني فان الضوء الذي يحصل في سطح الجسم الصقيل يشرق من كل نقطة منه ضوء إلى البصر المقابل له فيجتمع الضوءان في البصر ، فلذلك يكون قوياً . والضوء الذي يرد إلى البصر من سطوح الأجسام الخشنة هو الضوء الثاني فقط ، وهو الضوء الذي يشرق من كل نقطة من الضوء الذي في الجسم الخشن . فالضوء الذي يدركه البصر من سطح الجسم الصقيل ليس قوته من أجل زيادة القوة القابلة التي في الجسم [٥٠ و] الصقيل ، وإنما قوته للعلة التي ذكرناها . وضعف الضوء الذي يدركه البصر في الجسم الخشن ليس هو أيضاً من أجل ضعف القوة القابلة ، وإنما هو لنقصان قوة الضوء الثاني الذي يرد إلى البصر . وقد بينا في كتابنا في المناظر أن الضوء الثاني يكون أبداً أضعف بكثير من الضوء الأول . وقد تبين أن الضوء الذي يدركه البصر في سطح القمر ليس شيء منه بالانعكاس . فليس الضوء القوي الذي يدركه البصر في سطح القمر من أجل صقاله (١٢) ، وليس الضوء الضعيف الذي يدرك في موضع الأثر من أجل خشونته .

وأيضاً فان الضوء الذي يدركه البصر في سطح الجسم الخشن إذا كان الجسم الخشن ذا لون واحد،وكان نقي اللون ، فليس يوجد في تضاعيفه ظلمة ولا اختلاف ، بل يوجد متشابه الضوء . والأثرالذي في القمر يوجد أبداً مضيئاً دون إضاءة بقية سطح القمر . ومع ذلك يوجد فيه ظلمةمتشكلة بشكل لا يتغير وكأنه كدر في صفو . فلو كان ذلك الأثر لخشونة موضع الأثر لقد كان يكون الضوء فيه ضعيفاً فقط ولا يكون فيه ظلمة ولا لون ، والوجود بخلاف ذلك . وإذا كان ذلك كذلك فليس الأثر الذي في القمر من أجل خشونة في سطح القمر .

وأما قول من يقول إن الأثر إنما هو لخشونة بارزة أجزاؤها شاخصة ، فاذا أشرقت الشمس على سطح القمر صار للأجزاء الشاخصة أظلال على ما يليها وفيما بينها من سطح القمر ، فان هذا الرأي ينتقض بما نذكره : وهو أن القمر ليس هو ثابتاً على وضع بالقياس إلى الشمس ، لأنه كلما بعد عن الشمس تغير وضعه منها . فلو كان الأثر أظلال أشخاص خشونة بارزة . لقد كان يتغير موضعه من سطح القمر بتغير وضع القمر من الشمس ، ويتغير أيضاً شكل مجموع الأظلال . وليس يوجد شكل الأثر متغيراً في وقت من الأوقات ، بل شكله أبداً على صفة واحدة .

وأيضاً فان القمر في وقت مقابلة الشمس يكون سطحه المضيء مواجهاً للشمس . فلو كان في سطحه أشخاص بارزة لكان عند مقابلة الشمس ومواجهتها يصل ضوؤه الى الخلل الذي بين تلك الأشخاص الذي عليه كان يقع الأظلال عند كون القمر قريباً من الشمس . والوجود بخلاف ذلك ، لأن الأثر يوجد أبداً في وقت مقابلة الشمس على الصفة التي يوجد عليها قبل وقت المقابلة وبعدها على الشكل بعينه الذي هو له دائماً . فليس الأثر الذي في القمر أظلال خشونة بارزة في سطح القمر .

وأمّا رأي من يقول إن الأثر هو تقعير في جسم القمر وإن الشمس إذا أشرقت على القمر صار لمحيط التقعير ظل على باطنه فان ذلك ينتقض بمثل القول الذي تقدم في الخشونة البارزة . وذلك أن [٥٠ ظ] القمر إذا قابل الشمس وصل ضوء الشمس الى باطن التقعير ، فيبطل الظل الذي يكون من محيط التقعير عند كون القمر قريباً من الشمس . فان قيل إن القمر في وقت المقابلة للشمس ليس يكون في حقيقة المقابلة ، أعني أنهما ليس يكونان على طرفي قطر بل يكون القمر مائلا عن طرف القطر الذي يمر بمركز الشمس ، فيصلح أن يكون لمحيط التقعير ظل في وقت المقابلة ، ويلزم مثل ذلك في الخشونة البارزة أيضاً ، فالجواب عن هذا القول هو أن ميل القمر عن حقيقة المقابلة إن كان يوجب أن يكون لمحيط التقعير ظل ، فعلى تصاريف الأحوال ليس يكون ظل لمحيط التقعير عند المقابلة على مثله قبل المقابلة . لأنه قبل المقابلة ليس يصل الضوء إلى باطن التقعير كما يصل عند المقابلة . فيلزم من ذلك إن كان القول الذي ادعي ممكناً ، أعني ، إن كان في القمر تقعير ، أن يكون ظل محيطه عند المقابلة أصغر بكثير من ظله قبل المقابله . فان وضع القمر من الشمس يتغير في كل ساعة من الساعات . فيلزم أن يكون الأثر يتغير شكله ومقداره في كل ساعة من الساعات ، ويلزم هذا المعنى بعينه في أظلال الأشخاص البارزة . والوجود بخلاف ذلك ، وهو أن الوجود هو أن شكل الأثر ليس يتغير لا عند المقابلة ولا في وقت من الأوقات التي قبل المقابلة وبعدها فليس الأثر الذي في القمر ظلاً لتقعير ولا لخشونة بارزة .

وأمّا رأي من يقول إن في السماء موضعاً فيه بعض الكثافة ، وهو متوسط بين القمر والشمس ، وإن الضوء إذا أشرق على القمر كان لذلك الموضع ظل على سطح القمر ، فان ذلك يبطل بما نذكره : وهو أنه إن كان بين ذلك الموضع وبين القمر بعد مقتدر فانه يكون لـه اختلاف منظر . فيبطل هذا الرأي كما بطل رأي من يقول إنه بخار . وإن كان البعد الذي بينه وبين القمر بعداً يسيراً وليس له اختلاف منظر من أجل قربه منه ، فان هذا الموضع هو في فلك القمر وقريباً من جرم القمر ، فالجواب هو أن هـذا الموضع إما أن يكون في فلك التدوير أو في الفلك المحيط بفلك التدوير . فان كان في الفلك المحيط بفلك التدوير ، فان فلك التدوير إذا تحرك بحركته التي تخصه ، أعني حركته حول مركزه ، حرك القمر . فاذا حرك القمر خرج القمر عن السمت الذي صار من بعد بينه وبين الشمس ، فيبطل الأثر الذي في القمر . والوجود بخلاف ذلك، أعني أن القمر ليس يوجد في وقت من الأوقات خالياً من الأثر لجزء (١٣) كثيفاً

في الفلك المحيط بفلك التدوير . فان كان هذا الموضع الكثيف في فلك التدوير قريباً من جرم القمر ، فانه يكون في جهة واحدة بعينها [٥١ و] من جهات القمر ، لأنه ليس يتغير وضعه من فلك التدوير ، لأن كل جزء من كل جسم فليس يتغير وضعه من ذلك الجسم إلا أن يتحرك فيخرق ذلك الجسم ، وليس يجوز أن ينخرق جسم فلك التدوير . فموضع الجزء الكثيف من فلك التدوير ليس يتغير . وموضع القمر من فلك التدوير ليس يتغير (١٤) . فهذا الوضع الكثيف ليس يكون إلا في جهة واحدة بعينها من جهات القمر. والشمس أبداً إما أن تكون غربية عن القمر وإمّا شرقية : أما من أول الشهر إلى وقت الاستقبال فان الشمس تكون غربية عن القمر ، وأما من وقت الاستقبال إلى آخر الشهر فانها تكون شرقية ، ومن أول الشهر إلى وقت الاستقبال يكون فلك التدوير قد حرك القمر ونقله من جهة إلى جهة . فاذا كانت الشمس والقمر والجزء الكثيف متوسط بين الشمس والقمر فليس يثبت على هذا الموضع إلا زماناً يسيراً ، ثم يحركه فلك التدوير بدور هذا الجزء الكثيف وبدور القمر ، فيخرج الكثيف عن السمت الذي بين الشمس والقمر ، فيصير تارة شمالياً عن هذا السمت وتارة جنوبياً ، [وتارة] يكون هذا الجزء الكثيف شرقياً عن جرم القمر والشمس غربية عنه ، وتارة غربياً عنه والشمس شرقية عنه ، فيصير القمر في كثير من الأوقات قاطعاً للسمت الذي بين الجزء الكثيف وبين الشمس ، فليس يكون للجزء الكثيف ظل على سطح القمر إلا أوقاتاً مخصوصة ويكون القمر أكثر الزمان خالياً من هذا الظل . فيلزم من هذا الرأي أن يكون الأثر موجوداً في القمر في بعض الأوقات ، وفي أكثر الأوقات يكون خالياً من الأثر . والوجود بخلاف ذلك ، وهو أن الأثر يوجد أبداً في سطح القمر وفي موضع مخصوص منه على شكل واحد بعينه ومقدار واحد بعينه . فليس الأثر الذي في القمر من أجل موضع كثيف في السماء .

وقد تبين من (١٥) جميع ما بيناه فساد الآراء التي قدمنا ذكرها . وقد تبين أيضاً أن الأثر هو في نفس جرم القمر ، إذ قد تبين أنه ليس هو لمعنى خارج عن جرمه ولا صورة تظهر بالانعكاس . فقد بقي أن نبين مائية هذا الأثر فنقول :

إن جوهر القمر مخالف لجوهر جميع الكواكب الباقية . والدليل على ذلك أن جميع الكواكب مضيئة من ذواتها لا من إشراق الشمس عليها ، وقد بينا هذا المعنى بياناً واضحاً في كتابنا في أضواء الكواكب . وإذ كانت الكواكب مضيئة من ذواتها من غير حاجة إلى إشراق الشمس عليها ، وكان القمر غير مضيء من ذاته إلا بعد أن تشرق عليه الشمس فجوهر القمر إذاً مخالف لجوهر جميع الكواكب . وإذا كان جوهر القمر مخالفاً لجوهر جميع الكواكب فغير ممتنع أن يكون في أجزائه اختلاف إما في جوهرها وإما في كثافتها وإما في أضوائها . وإذا كان ذلك كذلك [٥١ ظ] فانا نقول قولا جازماً إن جرم القمر غير متشابه الأحوال في جميع أجزائه . والدليل على ذلك أن جرم القمر لو كان متشابه الأجزاء في جميع أحواله لكان ضوؤه الذي يظهر في شخصه متشابهاً في جميع أجزائه ، وليس ضوؤه متشابهاً في جميع أجزائه من أجل الأثر الذي يظهر فيه . وقد تبين أن الأثر ليس هو لمعنى خارج عن جرمه ولا بالانعكاس .

وإذا لم يكن الأثر لمعنى خارج عن جرمه ولا بالانعكاس فالأثر هو في نفس جرم القمر. وإذا كان الأثر في نفس جرم القمر فليس ضوؤه متشابهاً في جميع أجزائه بل ضوء بعض أجزائه مخالف لضوء بقية أجزائه. وإذا كان ضوء أجزائه مختلفاً فليس جرمه متشابه الأحوال في جميع أجزائه. فموضع الأثر إذاً من جرم القمر مخالف لبقية جرم القمر نوعاً من الاختلاف من أجله كان ذلك الموضع مخالف الضوء لبقية جرمه.

وإذا كان القمر يقبل الضوء من الشمس قبولا مختلفاً وهو في نفسه غير مضيء فهو إذاً يقبل الضوء من الشمس قبولا مختلفاً. لأنه لو قبل الضوء قبولاً متشابهاً لكان ضوؤه متشابهاً في جميع أجزائه. وإذا كان ضوؤه ليس بمتشابه، بل موضع الأثر أقل إضاءة ونوراً من بقية جرمه، فليس قبوله للضوء قبولاً متشابهاً. وإذا كان قبوله للضوء ليس قبولا متشابهاً فموضع الأثر ليس يقبل الضوء كقبول بقية جرم القمر. فنوع الاختلاف الذي في جرم القمر الذي به يخالف موضع الأثر منه بقية جرمه هو معنى يمنع قبول الضوء منعاً ما. فجرم القمر إذن مختلف الأجزاء وموضع الأثر منه يخالف بقية أجزائه بمعنى يمنعه من قبول الضوء قبولا تاماً. وإذ ذلك كذلك فحقيقة مائية الأثر هو أنه ظلمة في جرم القمر سببها أن ذلك الجزء ليس يقبل الضوء قبولا تاماً. فقد بقي أن نبحث عن مائية المعنى الذي يمنع الجزء المتأثر من قبول الضوء القبول التام، فنقول:

إن كل جسم مشف فهو قابل للضوء ومؤد للضوء وكل جسم كثيف فهو قابل للضوء غير مؤد للضوء. فأما الدليل على أن الجسم المشف قابل للضوء فهو نفوذ الضوء فيه، فلو لم يقبل الضوء لما أمكن أن ينفذ الضوء فيه، ونفوذ الضوء فيه بيّن، فقبوله بيّن. وأما الدليل على أن الجسم الكثيف يقبل الضوء فهو ظهور الضوء في سطحه، وثبوته فيه، فلو لم يقبل الضوء لما ثبت في سطحه ولا ظهر، وأيضاً فان كل جسم فيه بعض الشفيف وفيه بعض الكثافة، كالزجاج والماء والأحجار المشفة إذا أشرق عليها الضوء نفذ فيها بعض النفوذ وظهر فيها بعض الظهور، فهي قابلة للضوء على الوجهين جميعاً. وأيضاً فان الأجسام الكثيفة [٥٢ و] المختلفة إذا أشرق عليها الضوء كانت صورة الضوء فيها مختلفة، ويكون ذلك الاختلاف بحسب ألوانها وبحسب صقالها وخشونتها وبحسب قوة كثافتها وضعفها. وكذلك الأجسام المشفة المختلفة التي فيها بعض الكثافة يظهر الضوء فيها ظهوراً مختلفاً ويكون بحسب ألوانها وبحسب الكثافة التي فيها وبحسب صقالها وخشونتها والأجسام المتشابهة في جميع أحوالها إذا أشرق عليها الضوء كانت صورة الضوء التي فيها صورة متشابهة لا اختلاف فيها. والأجسام المختلفة في ألوانها وكثافتها وصقالها وخشونتها تظهر صورة الأضواء عليها ظهوراً مختلفاً. والذي يتحصل من جميع ذلك هو أن كل جسم ففيه قوة قابلة للضوء، وأن الجسم المتشابه الأجزاء في جميع أحواله تكون القوة القابلة في جميع أجزائه متشابهة وتكون صورة الضوء التي تظهر[١٦] فيه متشابهة في جميع أجزائها، وأن الجسم المختلف الأجزاء تكون القوة القابلة في أجزائه مختلفة فتكون صورة الضوء التي تظهر فيه مختلفة.

وإذ قد تبين ذلك فقد تبين أن في القمر قوة قابلة للضوء . لأنه قد تبين أن الضوء الذي يظهر فيه هو ضوء يقبله من الشمس . وإذا كان يقبل الضوء من الشمس وكان الضوء ثابتاً فيه وظاهراً في سطحه فان فيه قوة قابلة للضوء . وقد تبين أن القوة القابلة التي فيه هي في أجزائه مختلفة ، لأن صورة الضوء التي تظهر في القمر هي صورة مختلفة وليست متشابهة الأجزاء . وإذا كان الجسم إنما يقبل الضوء من أجل القوة القابلة التي فيه ، فان قوة الضوء وضعفه إنما يكون من أجل زيادة القوة القابلة ونقصها ، أو من أجل شدتها وضعفها (١٧) . فاختلاف الضوء الذي يظهر في القمر إنما هو لاختلاف القوة القابلة التي في أجزاء جرم القمر . وإذ جميع ذلك كذلك فمائية المعنى الذي(١٨) يمنع(١٩) الجزء المتأثر الذي يوجد في القمر من قبول الضوء القبول التام هو ضعف القوة القابلة للضوء التي في الجزء المتأثر وقصورها عن القوة القابلة التي في بقية أجزاء القمر . وهذا المعنى هو علة الأثر ، واختلاف هذه القوة في أجزاء جرم القمر إنما هو(٢٠) لاختلاف كيفية أجزاء جرم القمر . فقد بقي ان نبحث عن العلة التي من أجلها كانت هقوة القابلة التي في موضع الأثر أضعف من القوة القابلة التي في بقية جرم القمر ،وهذه العلة إنما الي كيفية الجزء من جرم القمر المتأثر بالأثر ، فنقول :

إن كل جسم مشف فانه يقبل الضوء ويؤديه إلى ما وراءه ، وكل جسم غير مشف فليس يؤدي الضوء إلى ما وراءه [٥٢ ظ] ، فنقول إن القوة القابلة غير الشفيف . والدليل على ذلك أن الجسم المشف إذا أشرق عليه الضوء ثبت الضوء فيه ونفذ أيضاً فيه ، والثبوت غير النفوذ ، وهما متضادان ، فالمعنى الذي به يثبت الضوء في الأجسام المشفة هو غير المعنى الذي به ينفذ الضوء فيها . وقد تبين أن المعنى الذي ينفذ الضوء هو الشفيف ، فالمعنى الذي يثبت الضوء هو غير الشفيف .

فأما أن الضوء يثبت في الأجسام المشفة فقد بيناه في كتابنا في المناظر عند كلامنا في خواص الأضواء . وذلك أنا بينا هناك أن الضوء ينفذ في الهواء وفي الأجسام المشفة ومع ذلك فان كل نقطة من الجسم المشف إذا نفذ فيه الضوء فانه يشرق منها ضوء ثان إلى كل نقطة تقابلها . ولو كان الضوء ينفذ فقط في الجسم المشف ولا يثبت فيه لما كان يشرق من كل نقطة من الجسم المشف ضوء ثان يصدر عنه هذه الأضواء . وإذا كان في الجسم المشف ضوء ثابت قد قبله الجسم المشف مع نفوذ الضوء فيه ، فان القوة التي في الهواء وفي الأجسام المشفة التي يثبت الضوء فيها هي غير الشفيف وهي القوة القابلة التي في الجسم المشف ، لأن المعنى الذي به يكون الثبوت هو القبول ، فكل جسم مشف فيه قوة قابلة وقوة مؤدية وكل واحدة منهما غير الأخرى.

وكل جسم كثيف إذا لم يكن فيه شيء من الشفيف فليس يصل الضوء إلى باطنه . والدليل على ذلك أن الجسم الكثيف إذا أشرق عليه الضوء ، وثبت الضوء في سطحه ، متى قطع من الجهة المضادة لجهة الضوء لم يوجد في موضع القطع شيء من الضوء . والجسم المشف الذي فيه شيء من الشفيف إذا قطع وجد الضوء في موضع القطع . وكل جسم كثيف ففي

ظاهره قوة قابلة للضوء . وإذا كان الجسم المشف يصل الضوء الى باطنه ، وكان كل موضع من الجسم المشف يقبل الضوء ، وكان كل جسم كثيف إذا وصل الضوء إلى سطحه قبله وثبت فيه ، فكل جسم يصل إليه الضوء فانه يقبل الضوء . وإذا كان ذلك كذلك فكل جسم فيه قوة قابلة للضوء إذا وصل الضوء إليه قبله . وليس شيء يمنع من وصول الضوء الى الأجسام إلا الكثافة ، فان الكثافة ، التي في الجسم تمنع الضوء من الوصول الى باطن الجسم . وكل جسم لا يصل الضوء الى سطحه فانما ليس يصل الى سطحه لأن ساتراً كثيفاً يمنع الضوء من الوصول الى سطحه . فالكثافة التي في الساتر هي التي تمنع الضوء من الوصول إلى سطح الجسم المستتر. وإذا كان كل جسم يصل الضوء إليه ففيه قوة قابلة [٥٣ و] للضوء ، وكان كل ضوء يصل الى الأجسام يقبله الأجسام ، وكانت المواضع التي لا يصل إليها الضوء من أجل الكثافة ، فالكثافة هي إذن العلة المانعة للأجسام من قبول الضوء مع منعها الأجسام المشفة من تأدية الأضواء وتنفيذها[٢١] . وليس شيء يمنع الأجسام من قبول الضوء غير الكثافة ، لأنه ليس شيء يمنع الضوء من الوصول إليها غير الكثافة .

وأيضاً فانا نجد الأجسام تقبل الضوء قبولا مختلفاً وذلك أن الجسم الأبيض يقبل الضوء أكثر من قبول الجسم الأسود . وكذلك جميع الأجسام المتلونة تقبل الأضواء قبولا مختلفاً بحسب ألوانها. وكلما كان من الأجسام أصفى لوناً كان أشد قبولا للضوء وكان الضوء الذي يظهر فيه أقوى وكلما كان من الأجسام أظلم لوناً كان أضعف قبولا للضوء وكان الضوء أضعف [٢٢] إذا تساوت الأضواء التي تشرق على جميع الأجسام المتلونة . وإذا أشرق على الجسم المتلون ضوء قوي ظهر لونه مشرقاً رقيقاً أو فيه بعض الرقة وظهر الضوء الذي فيه قوياً . وإذا أشرق عليه ضوء ضعيف ظهر لونه قوياً وظهر الضوء الذي فيه ضعيفاً . وعلة ذلك هي أن كل ضوء يدركه البصر في جسم متلون فهو يدركه ممتزجاً باللون الذي في ذلك الجسم ، فصورة اللون تكسف[٢٣] الضوء وصورة الضوء تضعف اللون . وقد بينا هذا المعنى بياناً واضحاً في كتابنا في المناظر . واللون أبداً يتبع الكثافة التي هي ضد الشفيف ، وليس يوجد اللون إلا مع الكثافة لأن كل جسم ليس فيه شيء من الكثافة ، أعني الذي في غاية الشفيف ، فليس فيه شيء من اللون .

ولسنا نقول إن اللون هو الكثافة ، لأنه قد يكون جسم كثيف شديد الكثافة صافي اللون كالحجارة البيض ، وقد يكون جسم فيه بعض الشفيف وهو مظلم اللون كالعقيق والزمرد وما جرى مجراهما ، فصورة اللون غير صورة الكثافة . إلا أن اللون ليس يكون إلا في جسم كثيف أو فيه بعض الكثافة ، وليس يوجد اللون في جسم مشف لا كثافة فيه . فالكثافة موضع صورة اللون وصورةُ اللون حلية له ، فهي كالهيولي للون ، والكثافة مع اللون هما كالهيولي والصورة اللذين يوجدان أبداً معاً ولا يوجد واحد منهما بالحس منفرداً عن صاحبه . وإذا كانت الكثافة هيولى لصورة اللون فشدة الكثافة تزيد في ظلمة اللون المظلم وتنقص من صفاء

اللون الصافي . والزيادة في ظلمة اللون المظلم والنقصان من صفاء اللون الصافي يكسفان الضوء الذي يكون في الجسم المضيء . فالكثافة [٥٣ ظ] في كل جسم مضيء تكسف(٢٤) الضوء الذي في الجسم المضيء . وإذا كانت الكثافة تكسف الضوء في كل جسم مضيء فالكثافة إذن تعوق أبداً القوة القابلة للضوء وتضعفها . وإذا كان ذلك كذلك فكل كثافة فهي مانعة للأجسام من قبول الضوء مع حصول قوة القبول فيها . وإنما يثبت الضوء في الأجسام الكثيفة ويظهر فيها من أجل زيادة قوة القبول على قوة المنع . والمنع الذي توجبه الكثافة يختلف بالأشد والأضعف ، فاذا تساوت القوة القابلة للضوء في الأجسام الكثيفة واختلفت الكثافة في الأجسام الكثيفة كان المنع في الأجسام التي هي أشد كثافة أقوى ، فتكون الأضواء التي في الأجسام التي هي أشد كثافة أضعف .

وإذ قد تبين جميع ذلك فلنرجع إلى حال القمر فنقول : إن القمر يقبل الضوء من الشمس ، وليس فيه شيء من الشفيف ، ففي القمر إذن القوة القابلة للضوء وليس فيه القوة المنفذة للضوء . وقبول القمر للضوء مع عدم الشفيف فيه هو دليل واضح على أن القوة القابلة للضوء هي غير القوة المنفذة له . وفي هذا الدليل تأكيد لما قدمناه من قبل أن القوة القابلة هي غير القوة المنفذة التي في الأجسام المشفة . وقد تبين أن قبول القمر للضوء هو قبول مختلف ، وأن بعض أجزائه يقبل الضوء قبولا تاماً وبعضها ، وهو موضع الأثر ، ليس يقبل الضوء قبولا تاماً ، وأن ذلك لعائق يعوق موضع الأثر عن القبول التام . وإذا كان في جميع جرم القمر قوة قابلة للضوء وكان موضع الأثر الذي ليس يقبل الضوء قبولا تاماً لا يقبل الضوء (٢٥) لعائق يعوقه . وكان قد تبين أن الكثافة تعوق القوة القابلة للضوء ، وأنه ليس شيء يعوق القوة القابلة غير الكثافة ، وأن الكثافة كلما كانت أشد كان منعها للقوة القابلة للضوء أقوى ، فضعف القوة القابلة التي هي في موضع الأثر إنما هي بقوة الكثافة التي في ذلك الموضع ، فموضع الأثر إذن إنما ليس يقبل الضوء قبولا تاماً لأن فيه كثافة تعوقه عن القبول التام .وجميع القمر كثيف . وإذا كان ذلك كذلك فموضع الأثر من القمر فيه كثافة زائدة على الكثافة التي في جميع جرم القمر ، وهذه الزيادة هي التي تعوقه عن القبول التام . فالعلة التي من أجلها كانت القوة القابلة للضوء التي في موضع الأثر أضعف من القوة القابلة التي في بقية جرم القمر هي زيادة كثافة موضع الأثر على الكثافة التي في بقية جرم القمر . وهذا هو الذي قصدنا لتبيينه في هذا البحث .

وقد تبين أن كل جسم متلون إذا أشرق عليه ضوء قوي ظهر لونه رقيقاً أو فيه بعض الرقة وظهر [٥٤ و] الضوء الذي فيه قوياً . وإذا أشرق عليه ضوء ضعيف ظهر لونه قوياً ، أعني أشبع وأظلم من لونه إذا أشرق عليه ضوء قوي ويظهر الضوء الذي فيه ضعيفاً . وعلة ذلك هي أن كل ضوء يدركه البصر في جسم متلون فهو يدركه ممتزجاً بالضوء الذي في ذلك الجسم . وللقمر لون يخصه يظهر في وقت كسوفه وخاصة إذا انكسف جميعه ، ويظهر أيضاً في وقت كسوف الشمس وخاصة إذا انكسف جميعها أو معظمها ، وهو لون مظلم ، وهو

كأنه سواد تشوبه حمرة . وإذا اعتبر القمر في وقت كسوفه وجد لونه على ما ذكرناه . وأيضاً فان القمر في الليلة الثانية والثالثة من الشهر تظهر استدارته ويظهر محيطه مضيئاً ويظهر جرمه في وسط الاستدارة مظلماً . فلون القمر الذي يخصه هو لون مظلم ، والضوء الذي يظهر فيه في سائر الأوقات إنما هو الضوء الذي يستفيده من الشمس إذا أشرقت عليه ، والضوء الذي يحصل فيه من الشمس هو ضوء قوي ، والقوة القابلة للضوء الذي فيه هي في غاية القوة وأقوى من القوة القابلة التي في الأجسام الأرضية . فلفرط قوة الضوء الذي فيه وفرط القوة القابلة فيه خفي لونه المظلم الذي يخصه ، ومع ذلك فان لونه قد كسف(٣٦) الضوء الذي حصل فيه ، ولولا ظلمة لونه لكان ضوؤه أقوى مما هو عليه ، يدل على ذلك ما يظهر من ألوان الأجسام الأرضية إذا أشرق عليها ضوء الشمس . ولأن الضوء الذي في موضع الأثر ضعيف وليس هو في قوة الضوء الذي في بقية سطحه ، وجب أن يتلوح (٣٧) لونه الذي يخصه في هذا الموضع ممتزجاً بالضوء الذي فيه . ولأن الضوء الذي في هذا الموضع ليس هو في غاية الضعف ، وجب أن يظهر اللون خفياً . فالأثر الذي يظهر في وجه القمر هو لون القمر الذي يخصه ممتزجاً بالضوء الذي يحصل فيه . وإنما ظهر في هذا الموضع دون بقية سطح القمر لأن الضوء الذي في هذا الموضع أضعف من الضوء الذي في بقية سطح القمر . وضعف الضوء في هذا الموضع إنما هو لضعف القوة القابلة للضوء التي في هذا الموضع ، وضعف القوة القابلة التي في هذا الموضع إنما هو لزيادة كثافة هذا الموضع على كثافة بقية ما يظهر من سطح القمر . وذلك ما قصدنا لتبيينه في هذه المقالة .

تمت المقالة في الأثر الظاهر في وجه القمر ،
من قول الحسن بن الحسن بن الهيثم ،
والحمد لله رب العالمين وصلى الله على سيدنا محمد وآله وصحبه وسلّم .

تحقيقات

في هذه التحقيقات رمزنا لمخطوط مكتبة بلدية الإسكندرية رقم ٢٠٩٦ د بحرف «خ» ، ورمزنا لهامش هذا المخطوط بحرفي «هخ»

(١) شيء متوسط : الشيء المتوسط خ (مضروباً على الألف واللام في الكلمتين) .
(٢) ما : اما خ .
(٣) الأثر : الأمر خ .
(٤) اليه : (ناقصة من خ وأضيفت في هخ) .
(٥) لا يظهر : الا يظهر خ .
(٦) البحار : البخار خ .
(٧) وإذا : اذا خ .
(٨) وراءه : ورآ خ .
(٩) الصقيل : الجسم خ الصقيل هخ .
(١٠) فلذلك : فكذلك خ .
(١١) طبيعة : طبعه خ .
(١٢) صقاله : صقالة خ .
(١٣) لجزء : (كذا في خ) .
(١٤) وموضع القمر ... ليس يتغير : (ناقصه من خ وأضيفت في هخ) .

(١٥) من : في خ .
(١٦) تظهر : يظهر خ .
(١٧) وضعفها: أو ضعفها خ (مضروبا على الالف الأولى)
(١٨) الذي : التي خ الذي هخ .
(١٩) يمنع : تمنع خ .
(٢٠) هو : هي خ .
(٢١) وتنفيذها : وتنفيدها خ .
(٢٢) وكان الضوء أضعف : (كذا في خ ونقترح : وكان الضوء الذي يظهر فيه أضعف).
(٢٣) تكسف : تكثف خ .
(٢٤) تكسف : يكسف .
(٢٥) لا يقبل الضوء: (ناقصة من خ وأضيفت في هخ)
(٢٦) كسف : كثف خ .
(٢٧) يتلوح : (كذا في خ) .

«SUMMARY»

of Ibn al-Haytham's

"Treatise on the Marks Seen on the Surface of the Moon"

Edition of the Arabic text by

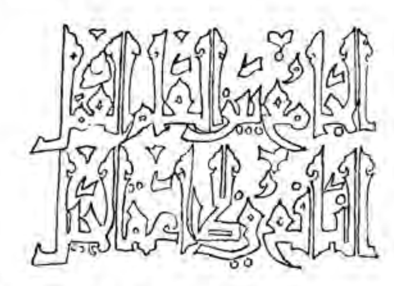
ABDALHAMID I. SABRA

A German translation of al-Haytham's "Treatise on the Marks Seen on the Surface of the Moon" *(Maqāla fil Athar al-ẓāhir fī wajh al-qamar)* was published by Carl Schoy in 1925, but the Arabic text of this *Treatise* has never been published. The present edition is based on the unique manuscript copy preserved in the City Library of Alexandria, no. 2096 D. It appears that this manuscript, now bound separately, was originally part of a volume which included three other works by Ibn al-Haytham all of which are at the Alexandria Library. This is indicated by the page numbers sometimes shown in these manuscripts and by the fact that they are all written in the same naskhi hand. No date is stated in our manuscript.

The present *Maqāla* is one of Ibn al-Haytham's later works and in it reference is made to his treatises on "The Light of the Moon" *(Fī Dawʾal-qamar)*, and "The Light of the Stars" *(Fī Aḍwāʾ al-kawākib)* and to his most important work on *Optics (Kitāb al-Manāẓir)*. A part from the specific problem dealt with in the *Treatise on the Marks on the Surface of the Moon*, Ibn al-Haytham repeats and sometimes elaborates his ideas on the radiation of light and colour which he set out in detail in the first chapters of the first *Maqāla* of the *Optics*. Particularly interesting in this respect are his statements towards the end of the present *Treatise* regarding colour and opacity.

الجامع بين العلم والعمل النافع في صناعة الحيل

لبديع الزمان أبو العز الرزاز الجزري



تحقيق

الدكتور المهندس أحمد يوسف الحسن

مدير معهد التراث العلمي العربي في جامعة حلب

بالتعاون مع :

الدكتور عماد غانم ومالك ملوحي

عاش المهندس العربي بديع الزمان أبو العز اسماعيل بن الرزّاز الجزري في ديار بكر في القرن السادس الهجري (الثاني عشر الميلادي) . وقد كني بالجزري لأنه كان من أبناء الجزيرة الواقعة بين الدجلة والفرات .

وقد خلف الجزري كتاباً في الهندسة الميكانيكية (الحيَل) يعتبر بحق أروع ما كتب في القرون القديمة والوسطى عن الآلات الميكانيكية والهيدروليكية . وقد اشتهر هذا الكتاب كثيراً في العالم الغربي وترجمت فصول كثيرة منه في الربع الأول من هذا القرن الى اللغة الألمانية من قبل كل من فيديمان وهاوسر[1] اللذين قاما بأبحاث هامة جداً في تاريخ العلم والتكنولوجيا عند العرب . كما صدرت مؤخراً ترجمة كاملة باللغة الانكليزية قام بها دونالد هيل الباحث المتخصص في تاريخ التكنولوجيا العربية وصدرت هذه الترجمة على شكل كتاب جيد الطباعة والاخراج .

ويحمل كتاب الجزري عنوان «الجامع بين العلم والعمل النافع في صناعة الحيل » ، وهذا هو نفسه العنوان الذي تحمله النسخ القديمة والجيدة من مخطوطات الكتاب ، وهي المخطوطات الموجودة في استانبول والتي تحمل الأرقام ٣٤٧٢ و ٣٦٠٦ و ٤١٤ . بينما تحمل النسخة المتأخرة التي ترجم عنها فيديمان وهاوسر (وهي نسخة اكسفورد رقم ٢٧) والتي ترجمها هيل أيضاً العنوان «كتاب في معرفة الحيل الهندسية » .

ومن عنوان الكتاب نشعر بأن الجزري جمع بين العلوم الميكانيكية النظرية التي كانت معروفة آنذاك وبين النواحي التطبيقية العملية . فهو كتاب نظري وعملي في آنٍ واحد .

(١) كافة المراجع موجودة في القسم الانكليزي من هذا البحث .

ومن دراسة فصول الكتاب ندرك رأساً بأن الجزري كان ضليعاً في فنه وانه كان ملماً بكل الفنون الميكانيكية والهيدروليكية المام الخبير الحاذق .

ونفهم من مقدمة كتاب الجزري أنه ألّف كتابه بطلب من ملك ديار بكر الملك الصالح ناصرالدين أبي الفتح محمود بن محمد بن قرا ارسلان بن داود بن سكمان بن أرتق ، الذي تولى الحكم في الفترة ٥٩٧–٦١٩ ﻫ (١٢٠٠–١٢٢٢ م) . ويقول الجزري أنه كان قبل ذلك في خدمة والد هذا الملك وفي خدمة أخيه ، وان خدمته تلك بدأت في عام ٥٧٠ هجريـــة وانه قضى خمسة وعشرين عاماً في خدمتهم . وقـــد حكم والد ناصرالدين خلال الفترة ٥٧٠–٥٨١ ﻫ (١١٧٤/٥–١١٨٥/٦ م) ، كما ان أخاه الأكبر تولى الحكم خلال الفترة ٥٨١–٥٩٧ ﻫ (١١٨٥/٦–١٢٠٠/١ م) [٢] .

ومن المؤسف أنه لم ينشر حتى الآن النص العربي الكامل للمخطوطة رغم ترجمتها كاملة الى اللغات الأجنبية . ومع ان الذين قاموا بالترجمة الى الألمانية أو الانكليزية إنما كانوا علماء ثقات جمعوا بين الالمام الجيد بالعلوم الهندسية وبين معرفة اللغة العربية (وهو أمر نادر بين المستشرقين) إلا ان الباحثين الذين علقوا على الترجمة الانكليزية التي قام بها دونالد هيل أشاروا الى أهمية نشر النص العربي . كما نبهوا الى النسخ الجيدة الموجودة في استانبول والتي كان من المفروض أن تتم الاستعانة بها بدلاً من نسخة اكسفورد[٣] .

لذلك كله قرّر معهد التراث العلمي العربي اصدار النص العربي الكامل لكتـــاب الجزري. ونحن ننشر اليوم نموذجاً لما سوف يكون عليه الكتاب بعـــد اكتمال تحقيقه . وقد اخترنا « النوع الخامس » الخاص بآلات رفع الماء .

ويهيب معهد التراث العلمي العربي بالباحثين ان يرسلوا اليه بآرائهم وتعليقاتهم على هذا الاسلوب حتى يعمد المحققون الى تفادي العثرات عند نشر النص الكامل . والى جانب النص المطبوع سوف تنشر الأشكال مرسومة بخطوطها الرئيسية وعليها الحروف الأبجدية المألوفة من أجل سهولة تتبع النص وفهمه ، في حين أن الأشكال الأصلية وعليها الرموز السرية سوف تنشر بالألوان كما وردت في المخطوطة رقم ٣٤٧٢ .

وقد استطاع المعهد ان يحصل على صور كافة مخطوطات الجزري المعروفة والموجودة في المكتبات العالمية المختلفة . وفي ملحق هذا الفصل كشف كامل بهـــذه المخطوطات . وبعد دراسة مقارنة لهذه المخطوطات اتضح بأن أفضلها بشكل مطلق هي ثلاثة موجودة الآن في استانبول وهي :

١ — المخطوطة رقم : توبقابي سراي رقم ٣٤٧٢

٢ — المخطوطة رقم : أيا صوفيا رقم ٣٦٠٦

(٢) أنظر Riefstahl

(٣) أنظر King

٣ – المخطوطة رقم : توبقابي سراي رقم ٤١٤

وربما كانت المخطوطة رقم ٣٤٧٢ اقدم هذه المخطوطات وهي مكتوبة عام ٦٠٢ ه او انها منقولة عن نسخة تحمل هذا التاريخ . وهي مخطوطة ممتازة بأشكالها وخطها وخلوها النسبي من الأخطاء سواء كان ذلك في النص أو في الأشكال والرسوم . وأشكالها ملونة بألوان بديعة . وقدتفضل الاستاذ الدكتور فؤاد سيزكين بامداد المعهد بفيلم اسود وأبيض وبفيلم آخر ملون لهذه المخطوطة الهامة . ويعود اليه الفضل أيضاً في الحصول على موافقة السيد وزير الثقافة التركي وعلى موافقة مدير مكتبة توبقابي سراي لنشرها .

ومن هنا فقد اعتمدنا النص الأصلي لهذه المخطوطة وعمدنا الى تصحيح أخطائه والى مقارنته بالمخطوطات الأخرى والتوصل من ذلك الى نص كامل صحيح من الوجهة الهندسية والتكنولوجية .

أما المخطوطة رقم آياصوفيا٣٦٠٦ فهي من أجمل وأدق مخطوطات الجزري . وقد انتزعت بعض لوحاتها الفنية وأصبحت موزعة في متاحف العالم أو لدى بعض الأفراد. ومعظم هذه اللوحات المنتزعة موجودة في الولايات المتحدة . ويرجع تاريخ هذه المخطوطة الى عام ٧٥٥ ه (١٣٥٤ م) . وقد استخدمناها لمقارنة النص مع المخطوطة رقم ٣٤٧٢ .

والمخطوطة الثالثة التي اعتمدنا عليها هي رقم توبقابي ٤١٤، وهذه مخطوطة شبه كاملة لا تقل في جودة أشكالها ورسومها وفي قلة أخطاء النص عن المخطوطتين السابقتين. ولم تكن هذه المخطوطة معروفة الى عهد قريب . وقد استخدمت أيضاً في مقارنة النص مع المخطوطتين السابقتين . ويعود تاريخ هذه المخطوطة الى عام ٦٧٢ ه (١٢٧٤م) .

وهناك مخطوطة رابعة استخدمناها في هذه الدراسة وهي مخطوطة اكسفورد رقم غريفز ٢٧ . ويعود تاريخها الى عام ٨٩١ ه (١٤٨٦ م) . ومع ان هذه المخطوطة متأخرة نوعاً ما عن المخطوطات الثلاث السابقة كما انها أكثر اخطاء سواء كان ذلك في النص الأصلي أو في الأشكال بالمقارنة مع المخطوطات الثلاثة السابقة ، الا أننا استخدمناها أيضاً لأنها هي النسخة الأساسية التي اعتمد عليها دونالد هيل في ترجمة كتاب الجزري كاملاً الى اللغة الانكليزية(٤) . كما ان كلاً من فيدِمان وهاوسر(٥) اعتمداها أيضاً في ترجمتهما لقسم كبير من كتاب الجزري الى اللغة الألمانية في الربع الأول من هذا القرن . ويبدو أنه لم تكن المخطوطات ٣٤٧٢ ، ٣٦٠٦ ، ٤١٤ متاحة للباحثين المشار اليهم عند قيامهم بترجماتهم . والمرجو الآن أن يساعد هذا النص العربي المدقق والمعتمد على أفضل المخطوطات المتاحة على توضيح وتصحيح كثير من المفاهيم حول نصوص الجزري التي ترجمت وجرى التعليق عليها باللغات الأجنبية .

(٤) أنظر المراجع في القسم الانكليزي.
(٥) أنظر المراجع في القسم الانكليزي .

النوع الخامس

في آلات ترفع ماء من غمرة وبير ليست بعميقة ونهر جار

الشكل الاول من النوع الخامس

(وهو آلة) (١) **ترفع ماء من غمرة الى مكان مرتفع بدابة تدير سهماً** . وأمثل صورة ذلك (وأكيّف عمله) (٢) يعمد الى غمرة ماء وعلى صورتها ههنا آ ويتخذ فيها ركنان ثابتان عليهما ك ل ويتخذ على رأسي الركنين محور طرفاه على الركنين . وعلى وسطه دولاب ذو حلقتين على (دايريهما) (٣) عارضات بعد ما بين كل عارضتين نحواً من فتر وعليه ي وعلى هذا المحور أيضاً ذنب مغرفة من خشب عليها (٤) م سعتها ما تسع من الماء نحو ثلاثين رطلاً بالبغدادي (وزايدا) (٥) على ذلك . وطول ذنبها من المحور الى الغمرة وهو ميزاب متى ارتفعت المغرفة من الغمرة مملوة ماء حتى توازي الأفق وزايداً على ذلك يسيراً فان الماء يجري في ذنب المغرفة (ويتفرغ) (٦) من طرفها الى ساقية . وعلى المغرفة ط وعلى طرف ذنبها ح ثم يتخذ ارفع من هذا المحور محور عليه ن وطرفاه في بيتين على ما ارتفع من ركني ك ل . وفي هذا المحور ربع دولاب ذو دندانجات بعد ما بينهن بعد ما بين عارضتين من دولاب ي وعلى هذا الربع من الدولاب س وهو يسامت دولاب ي وكل دندانجة منه بين عارضتين من دولاب ي وعلى طرف محور ن دولاب ذو دندانجات عليه ع ، وبين دندانجاته دندانجات دولاب في محور منتصب عليه ز وعلى المحور عند سهم في أعلاه معارض و وعلى السهم ج وفي طرف السهم رباط الى صدر دابة عليها هـ . وهذه صورة ذلك . فمن الواضح الجلي أنه متى دارت الدابة بالسهم فانه يدور دولاب ز ويدير دولاب ع وربع دولاب س ويدير دولاب العارضات وعليه ي ومغرفة ط مغموسة في الماء فترتفع مملوة من الماء . وعند تمام ربع دورة من المحور ترتفع كفة المغرفة (عن) (٧) موازاة الأفق فيجري ما فيها من الماء في ذنبها (ويتفرغ) (٨) من طرف ح

(١) في مخطوطة اكسفورد وردت (في آلات) .
(٢) في مخطوطة اكسفورد وردت عبارة : (فيما بعد الكلام على الشكل الآتي) .
(٣) في مخطوطتي (٣٦٠٦) و (٤١٤) وردت (دايرهما) .
(٤) في مخطوطة (٣٤٧٢) وردت : (عليها) .
(٥) في مخطوطة اكسفورد وردت : (أوزايدا) .
(٦) في مخطوطة (٣٤٧٢) وردت : (ويتفرع)
(٧) في مخطوطة (٤١٤) وردت : (عند) .
(٨) في مخطوطة (٣٤٧٢) وردت : (يتفرع) .

الى ساقية هناك . ثم (تنتهي) (٩) دندانجات ربع دولاب سَ فتعود المغرفة نازلة الى الغمرة بقوة شديدة فتغوص في الماء وتبقى بحالها حتى يدور محور نَ ثلاثة أرباع من دورة (وتصير) (١٠) أول دندانجة من ربع دولاب سَ بين عارضتين من دولاب يَ فتديره و (ترتفع) (١١) كفة المغرفة مملوءة من الماء حتى يتم دوران محور نَ ربع دورة ، وقد ارتفعت كفة المغرفة عن موازاة الأفق ويجري ما فيها في ذنبها الى الساقية وقد تم ربع الدورة وخلصت دندانجات سَ من بين عارضات دولاب يَ فتثقل الكفة وتقع الى الغمرة وكذلك ما دامت الدابة تدور وذلك ما أردت إيضاحه جليـاً .

وأصف ما صنعته وهو هذا الشكل وزيادة مغرفة أخرى (ومغرفتين وثلاث) (١٢) :

الشكل الثاني من النوع الخامس

وهو آلة ترفع الماء من غمرة أو بير بدابة تديرها . (وأمثّل ذلك وأكيفـه) (١٣) (تعمد) (١٤) الى بير ليست بعميقة وعليها في الصورة أآ فيوضع فيها ثلاثة أركان عليها لا ص ق وركن صَ (وهو) (١٥) الأوسط أقصر من ركني لا ق ثم تتخذ على ركني (لا صَ) (١٦) محور عليه دولاب ذو عارضات كعارضات السلالم وعليه فَ والى جانبه على المحور أيضاً طرف ذنب مغرفة (موثق به) (١٧) عليه عَ وعلى كفة المغرفة سَ ثم تتخذ على ركني صَ قَ محور عليه دولاب ذو عارضات وعليه نَ (والى جانبه) (١٨) على المحور أيضاً طرف ذنب مغرفة موثق به وعليه مَ وعلى كفة المغرفة لَ ثم تتخذ على ركني لا قَ محور يسامت (دولابي) (١٩) فَ نَ وتتخذ عليه ربع دولاب ذو دندانجات يسامت دولاب العارضات وعليه كَ ثم تتخذ عليه ربع دولاب ذو دندانجات يسامت دولاب العارضات وعليه يَ وهو مخالف لوضع ربع دولاب كَ ثم تتخذ على طرف هذا المحور (دولاب) (٢٠) ذو دندانجات عليه طَ وبين دندانجاته دندانجات

(٩) في مخطوطة (٣٤٧٢) وردت : (ينتهي) .
(١٠) في مخطوطة أكسفورد وردت : (يصير) / وفي مخطوطه (٤١٤) وردت : (ويصير) .
(١١) في مخطوطة اكسفورد و (٣٦٠٦) وردت : (ترفع) .
(١٢) في مخطوطة (٣٤٧٢) لم ترد عبارة : (ومغرفتين وثلاث) .
(١٣) في مخطوطتي اكسفورد و (٣٦٠٦) وردت العبارة : (وأمثل لذلك صورة بحيال صورة الشكل الأول وبعده ليفهم وأكيفه) .
(١٤) في مخطوطات اكسفورد و (٤١٤) و (٣٦٠٦) وردت : (يعمد) .
(١٥) في مخطوطة (٣٤٧٢) وردت : (هو) .
(١٦) في مخطوطة (٣٤٧٢) وردت : (لا ق) .
(١٧) في مخطوطة (٤١٤) وردت : (موثق عليه) .
(١٨) في مخطوطتي اكسفورد و (٣٦٠٦) وردت : (الى جانبه) .
(١٩) في مخطوطة اكسفورد وردت : (دولاب) .
(٢٠) في مخطوطة (٣٦٠٦) تنقص كلمة (دولاب) .

دولاب في محور منتصب وعليه ح وفي هذا المحور سهم و متصل بدابة تدور (فتدير) [٢١] بالسهم دولاب ح . فمن الواضح الجـلي انه متى دارت الدابة بسهم و دار دولاب ح [٢٢][وأدار دولاب ط ودندانجات ربع دولاب ك بين عوارض دولاب ف (فتديره وترتفع) [٢٣] كفة مغرفة س ويجري ما فيها ويخرج في طرف ع وتخلص دندانجات ك من دولاب ف فترجع كفة س بثقلها وتقع في الماء فتغوص . وربع دولاب ك بينه وبين دولاب ي ربع دورة ومتى كملت ربع الدورة فان دندانجات ي تنزل بين عارضات دولاب ن فيدور ربع دورة يرفع بها مغرفة ل حتى يخرج ما فيها من الماء في ذنبها وعليه م ويصب الى ساقية تجتمع بالأخرى . ثم يفارق ربع دولاب ي ويدور محوره ربع دورة حتى تصل دندانجات ربع دولاب ك الى بين عوارض (دولاب) [٢٤] ف وكذلك ما دامت الدابة تدور فان مغرفة س ترتفع ومغرفة (ل)[٢٥] تنخفض . ويمكن ان يعمل (هذا) [٢٦] بأربع دواليب ذوات عارضات في أربع محاور وفي كل محور مغرفة ويدير ذلك دابة واحدة بدولاب ح وعلى محوره أربعة أرباع دواليب وكل مغرفة يرفعها ربع دولاب] وهذه الحركة ضابطة نفسها بثقل واحد لا يخف ولا يثقل عما هي عليه . والشكلان المذكوران تخف الحركة في الشكل الأول منها ثلاثة أرباع الدورة وفي الشكل الثاني تخف نصف دورة . وذلك ما أردت إيضاحه جلياً . (الشكل ١)

وأصف ما صنعته وهو آلة ترفع ماء من بركة نحو عشرة أشبار :

الشكل الثالث من النوع الخامس

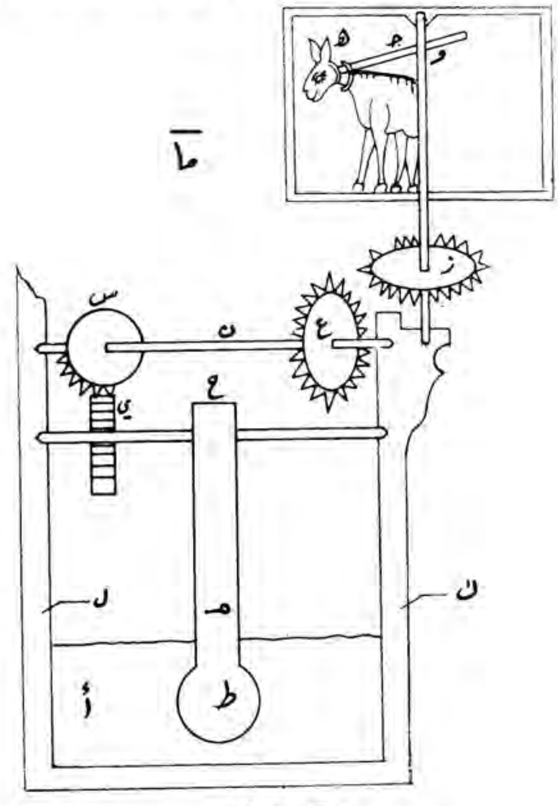
وهو بركة في (وسطها عمود مجوّف) [٢٧] عليه قرص وعلى القرص تمثال بقرة تدير دولاباً يرفع من البركة ماء [٢٨] الى فوق نحو من عشرة أشبار وينقسم الى فصلين :

الفصل الأول :

(في وصف) [٢٩] **صورة البركة وما فيها** : وهي بركة فيها عمود من نحاس وعلى

(٢١) في مخطوطتي اكسفورد و (٣٦٠٦) وردت : (فيدور) .
(٢٢) في مخطوطة (٣٦٠٦) تنقص من : (وأدار دولاب ط) وحتى : (وهذه الحركة ضابطة نفسها بثقل واحد) ، وقد أشر عليها بالقوس [ ] ، وهي صفحة كاملة من المخطوطة .
(٢٣) في مخطوطة (٤١٤) وردت : (فتديره وترفع) / وفي مخطوطة (٣٤٧٢) وردت : (فيديره وترفع) .
(٢٤) في مخطوطة اكسفورد تنقص كلمة (دولاب) .
(٢٥) في مخطوطة اكسفورد ينقص الرمز (ل) .
(٢٦) في مخطوطتي اكسفورد و (٤١٤) وردت : (هذا الشكل) .
(٢٧) في مخطوطة (٣٦٠٦) وردت : (في وسطها مجوف)
(٢٨) في مخطوطة (٣٦٠٦) وردت : (من البركة عمود عليه ما) / في مخطوطة (٤١٤) وردت : (من البركة الى فوق) .
(٢٩) في مخطوطات اكسفورد و (٤١٤) و (٣٦٠٦) وردت : (أصف) .

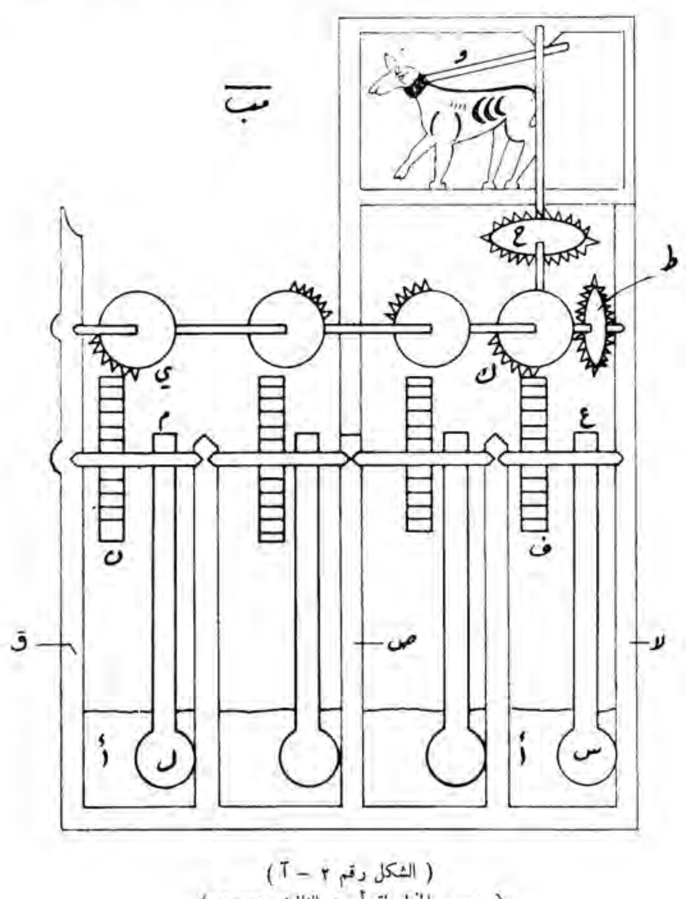
رأس العمود قرص من نحاس . وعلى القرص بقرة من خشب تدور فتدير سهماً في محور منتصب ارتفاعه (عن القرص ثمانية) (٣٠) أشبار . وفي أعلا المحور دولاب ذو دندانجات يدير دولاباً سندياً عليه حبلان فيهما كيزان . والحبلان موضوعان على ظهر الدولاب (ومنغمسان) (٣١) في الماء من البركة على ما جرت به العادة . والماء يتفرّغ من الكيزان الى ساقية داخل الدولاب ويجري منها الماء الى حيث اختير له . وقد تبين أن المحور المنتصب طوله نحو من ثمانية أشبار. وفي أعلاه دولاب يدير دولاباً سندياً قطره نحو من أربعة أشبار لان هذه الآلة يجتمع فيها



الشكل رقم (١)
(حسب المخطوطة رقم أحمد الثالث ٣٤٧٢)

(٣٠) في مخطوطات اكسفورد و (٤١٤) و (٣٦٠٦) وردت : (عن القرص نحو من ثمانية) .
(٣١) في مخطوطي اكسفورد و (٣٦٠٦) وردت : (متغمسان) .

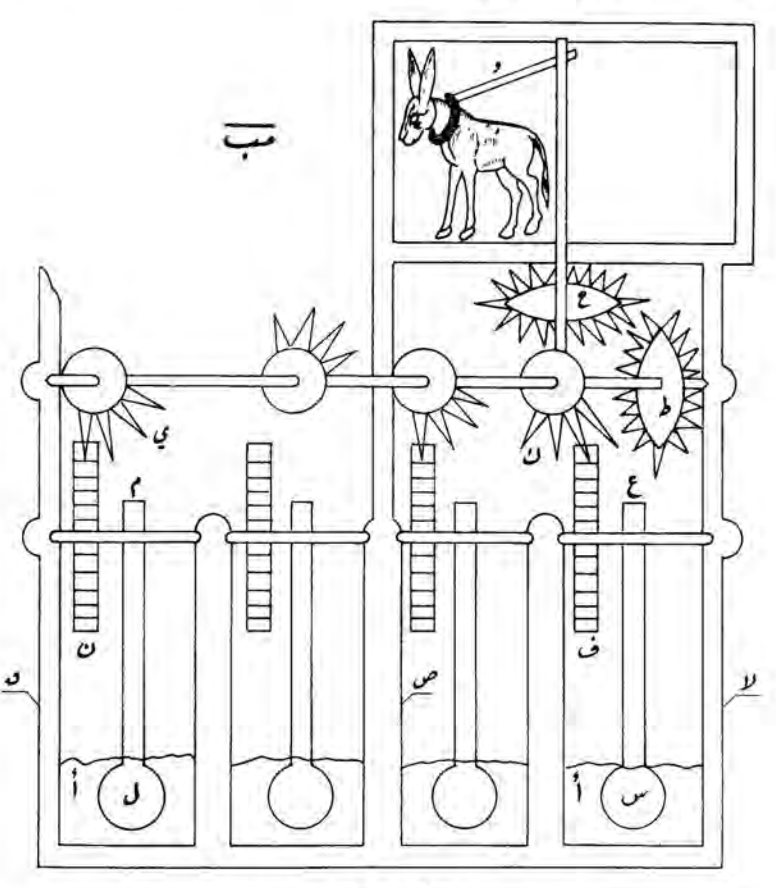
معنيان (٣٢) أحدهما رفع بعض الماء الأصلي الجاري الى البركة والانتفاع به في جهة أرفع من البركة والمعنى الآخر انها آلة مستحسنة بدواليب من نحاس فاخرة الصنعة رشيقة الأجسام



(الشكل رقم ٢ – آ)
(حسب المخطوطة أحمد الثالث ٣٤٧٢)

(٣٢) في مخطوطة (٣٦٠٦) وردت : (معيناً) .

لطيفة الوضع وحبال دقاق متخذة من حرير وكيزان لطاف مصبغات بأنواع الصباغ (٣٣) وكذلك الدواليب والبقرة والقرص .



(الشكل رقم ٢ – ب)
(حسب مخطوطة ايا صوفيا ٣٦٠٦)
واللوحة الاصلية موجودة في متحف الفن في بوسطون

(٣٣) في مخطوطات اكسفورد (و ٤١٤) (و٣٦٠٦) وردت : (الأصباغ) .

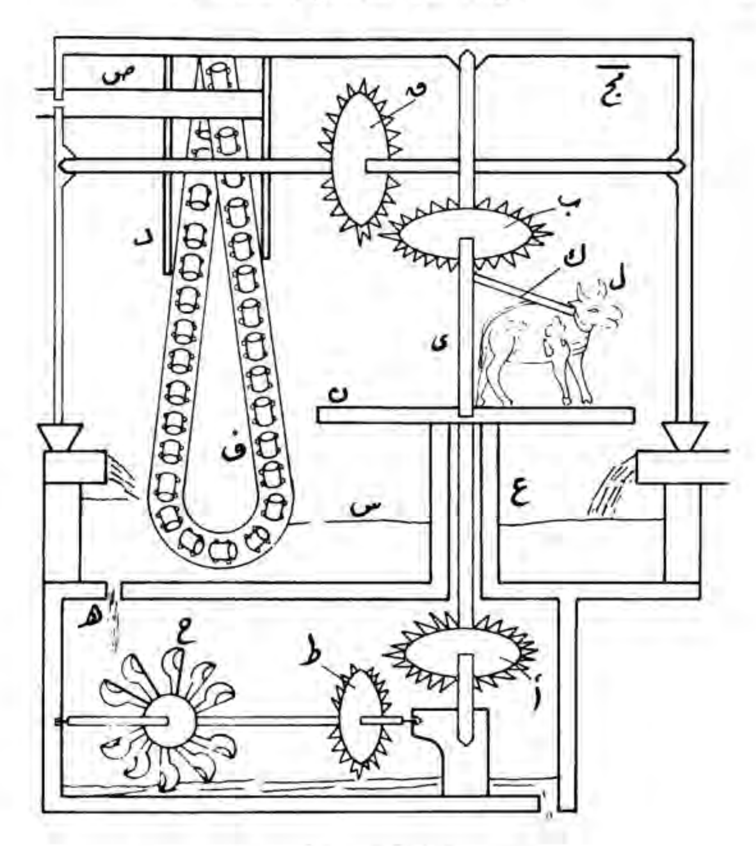
الفصل الثاني :

في كيفية عمل ما وصفت : تتّخذ بركة لطيفة أرضها صفيحة من نحاس (وحافتها)(٣٤) من رخام ، مربعة الشكل ، وتتّخذ في وسط البركة خرق عليه عمود مجوّف من نحاس منتصب ارتفاعه ارتفاع حافة البركة وعلى طرفه قرص من نحاس قطره نحو من شبرين وهو (مخروق الوسط) (٣٥) الى تجويف العمود وليكن ما تحت أرض البركة مجوّفاً تجويفاً عمقه نحو من ثمانية أشبار (متقن الصنعة) (٣٦) . وفي أرض التجويف وهو كبيت صغير مصرف لما يقع اليه من الماء . ثم تتخذ عموداً من حديد دقيق مقوّم طوله نحو من اثني عشر شبراً . ويدخل طرف هذا العمود في خرق وسط القرص (وفي عموده) (٣٧) الى تحت البركة (وتتخذ) (٣٨) على طرفه (دولاباً) (٣٩) قطره أربعة أشبار ذو دندانجات وتحت طرف العمود قاعدة مرتفعة عن أرض البيت . ثم تتخذ (محوراً) (٤٠) طوله ثلاثة أشبار وعلى طرفه دولاب قطره شبران ذو دندانجات موضوعة بين دندانجات دولاب طرف العمود الحديد وعلى طرفه الآخر دولاب ذو كفات كبار ما أمكن أن تتخذ في مثله وقطره نحو من سبعة أشبار. (وأمثّل لما وصفته وما أصفه صورة)(٤١) وهذه صورتهـــا (الشكل رقم ٣ أ والشكل رقم ٣ ب)

(وأقول أن علامة) (٤٢) البركة سَ وفي وسطها عمود غليظ عليه عَ وعلى رأسه قرص عليه نَ وفي وسطه خرق فيه العمود الحديد وعليه يَ وعلى طرفه المنحط الى البيت المتخذ تحت البركة دولاب آ وفي البيت دولاب الكفات وعليه حَ وعلى طرف محوره دولاب عليه طَ والماء الجاري الى البركة يخرج منه في أنبوب في أرض البركة وعليه هَ ويصب على كفات دولاب حَ نحو ثلثي الماء الجاري الى البركة فيدير دولاب الكفات . ودولاب طَ يدير دولاب آ وعمود يَ .

وأصف عمل البقرة فوق القرص ودولاب في رأس العمود والدولاب السندي وعليه الحبلان والكيزان : يتخذ في عمود يَ سهم معارض (طوله نصف قطر القرص) (٤٣) وعليه كَ ثم يتخذ بقرة لطيفة من خشب مجوّفة خفيفة ما أمكن ويوصل بين رقبة البقرة وبين

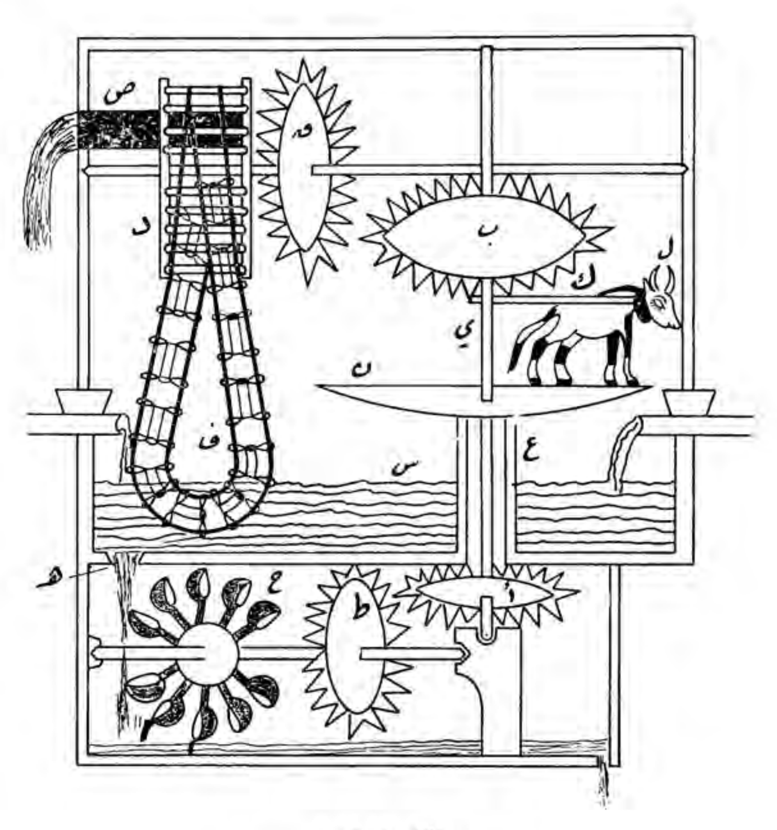
(٣٤) في مخطوطة (٣٤٧٢) وردت : (وحافتاها) .
(٣٥) في مخطوطة (٣٤٧٢) وردت : (مخروق الى الوسط) .
(٣٦) في مخطوطات اكسفورد و (٤١٤) و (٣٦٠٦) وردت : (متقن الصناعة) .
(٣٧) في مخطوطة (٣٤٧٢) وردت : (وفي العمود) / وفي المخطوطة (خ ٤١٤) وردت : (في العمودة) .
(٣٨) في مخطوطة اكسفورد وردت : (ثم تتخذ) .
(٣٩) في المخطوطات اكسفورد و (٤١٤) و (٣٦٠٦) وردت : (دولاب) .
(٤٠) في المخطوطات اكسفورد و (٤١٤) و (٣٦٠٦) وردت : (محور) .
(٤١) في مخطوطة (٣٤٧٢) وردت : (وأمثل لما وصفته صورة) .
(٤٢) في المخطوطة (٤١٤) وردت : (وأقول علامة) .
(٤٣) في مخطوطتي اكسفورد و (٣٦٠٦) وردت : (طوله نصف طول قطر القرص) .



(الشكل رقم ٣ أ)
(حسب المخطوطة أحمد الثالث ٣٤٧٢)

طرف سهم كـَ (برباط يليق بهما) (٤٤) وليكن موثقاً غير متحرك ليحمل السهم البقرة وترتفع يداها ورجلاها عن القرص نحواً من سمك شعيرة ومتى دار العمود بالسهم فان البقرة (لا تماس) (٤٥) أظلافها القرص وعليها لَ . ثم تتخـذ في رأس العمود دولاب ذو دندانجات

(٤٤) في مخطوطة اكسفورد وردت : (برباط يوثق بها) .
(٤٥) في مخطوطة (٣٤٧٢) وردت : (لا يماس) .



الشكل رقم ٣ ـ ب
(حسب المخطوطة ايا صوفيا ٣٦٠٦)

قطره نحو من شبرين وعليه بَ ثم (تتخذ) (٤٦) دولاب سندي قطره نحو من أربعة أشبار وعليه دَ ومحوره قصير وعلى طرفه دولاب ذو دندانجات قطره نحو من ثلاثة أشبار وعليه قَ وليكن دندانجات دولاب بَ بين دندانجات دولاب قَ ثم يتخذ خيطان من الحرير طول كل خيط متى جمع بين طرفيه ووضع على دولاب دَ تدلى فاضله الى أن يكاد يماس أرض البركة .

(٤٦) في مخطوطة (٣٦٠٦) وردت : (يتخذ) .

ثم يتخذ كيزان من نحاس كل كوز منها عظمه ما يسع من الماء نحو من ثلاثين درهماً وشكله مستطيل (ورأسه وأسفله واحدة) [٤٧] وفي رأسه رزتان متقابلتان وفي أسفله رزتان يقابلانهما ويشدّ فيهن الخيطان ويوضعان على الدولاب . وعلى الكيزان في الخيطين فـ . وعند تحرير ما وصفته تصبغ الدواليب والمحاور والكيزان والسواقي وجميع ما اتخذ من النحاس وغيره بألوان الأصباغ معجونة بدهن بذر الكتان الخالص مسحوقة به على الصلايا فان الماء لا يؤثر فيه ولا يغيره إلا في زمان طويل . وأما وضع طرفي محور الدولاب السندي والساقية التي ينصب اليها الماء وعليها صـ فعلى أعواد متخذة على رؤوس أساطين أربع دقاق متخذة حول البركة لا حاجة الى تصويرها . فمن الواضح الجلي أنه متى جرى الماء الى بركة سـ فانه يخرج منه في أنبوب هـ ما يدير دولاب حـ . ودولاب طـ يدير دولاب أ وعمود ى وبقرة لـ . ودولاب بـ يدير دولاب قـ ودولاب د وعليه كيزان فـ وهي مدلاة (تكاد تماس) [٤٨] أرض البركة . وكلما دار دولاب د ارتفعت الكيزان مملوة (وصبّت) [٤٩] في ساقية صـ ومنها الى موضع مختار . وذلك ما أردت إيضاحه جلياً .

وأصف ما صنعته وهو آلة ترفع ماء من غمرة أوبير غير عميقة :

الشكل الرابع من النوع الخامس

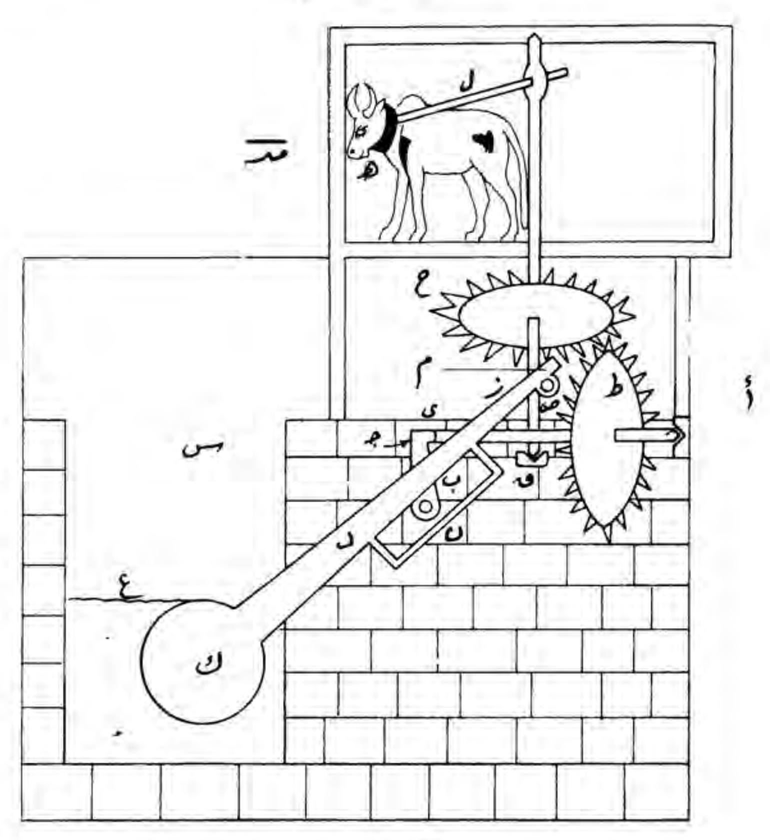
وهو آلة ترفع ماء من بير :

الفصل الأول :

وهي بير قد خرق اليها من جهة واحدة خرق من مسافة عشرة أذرع عن رأس البير على خط مستقيم الى سطح الماء من البير وأمثل صورة ذلك (الشكل رقم ٤):

وعلامة البير سـ وسطح الماء ع (وأول الخرق) [٥٠] ز ثم يتخذ عند أول الخرق دولاب ذو دندانجات قطره ستة (أشبار) [٥١] عليه طـ وعلى طرفي محوره وهو مبطوح أى وعلى ناحية ى سهم منتصب معطوف من رأسه على زاوية قايمة عليه جـ وعلى طرف السهم وتد عليه بـ وطرف أ من المحور في ركن ثابت على الارض وطرف ى زاوية قايمة وليس له طرف

(٤٧) في مخطوطة اكسفورد وردت : (ورأسه وأسفله سعة واحدة) .
(٤٨) في المخطوطتين (٣٤٧٢ و ٣٦٠٦) وردت : (يكود يماس) .
(٤٩) في المخطوطة (٣٤٧٢) وردت (وصب) .
(٥٠) في مخطوطة اكسفورد وردت : (وطول الخرق) .
(٥١) في مخطوطة (٣٤٧٢) وردت : (أشباراً) .



الشكل رقم ٤
(حسب المخطوطة أحمد الثالث ٣٤٧٢)

يدور في بيت بل دون الزاوية عند زَ يدور على قاعدة (ثابتة) (٥٢) ومانع يمنع المحور من الارتفاع عنها كالحلقة . ثم تتخذ مغرفة من خشب (لتسع كفتها نحو خمسين رطلاً) (٥٣) من الماء وطول ذنبها وهو (ميزاب) (٥٤) مقدار (ما يكون) (٥٥) من سطح الماء الى أول

(٥٢) في مخطوطة (٣٦٠٦) وردت : (ثانية) .
(٥٣) في مخطوطة اكسفورد وردت : (تسع ما نحو خمسين رطلا) .
(٥٤) في مخطوطة (٣٤٧٢) وردت : (ميزان) .
(٥٥) في مخطوطة (٣٤٧٢) وردت : (ما يمكون) / في مخطوطة (٤١٤) (ما يمكن) .

الخرق وفاصل عنه شبران وعليه دَ وعلى كفتها كَ وعلى طرف ذنبها مَ وفيه ثقب (فيه) (٥٦) محور معارض طرفاه في بيتين يدوران فيهما ولا يخرجان منهما وعلى المحور صَ و (تحت) (٥٧) ذنب المغرفة خرق مستطيل طوله ضعف طول سهم جَ ليتحرك فيه وتد رأس السهـم بسهولة وعليه نَ وليكن الوتد ملبساً (بصفيحة من حديد) (٥٨) وداخل خرق نَ ملبس (بصفيحة من حديد) (٥٩) ثم يتخذ على دولاب طَ دولاب ذو دندانجات قطره ثلاثة أشبار ومحوره منتصب وعليه حَ وعلى طرف محوره وهو يدور في اسكرجة ثابتة في الارض قَ وعلى الطـرف الاعلى (سهم معارض عليه لَ) (٦٠) وفي طرفه رباط متصل برقبة دابة تدير السهم وعليها هَ فمن الواضح الجلي أنه متى دارت دابة هَ (بسهم) (٦١) لَ دار دولاب حَ وأدار دولاب طَ ومحور أيَ وسهم جَ ووتد بَ (في خرق) (٦٢) نَ (في غاية انحطاطه) (٦٣) وكفة كَ منغمسة في الماء . ومتى دار سهم جَ نصف دورة مع المحور فان المغرفة ترتفع كفتها عن موازاة الأفـق ويجري الماء في ذنبها ويخرج من طرف مَ الى ساقية تمر حيث الاختيار وقد انتصب سهم جَ ثم ينخفض بتمام نصف دورة من المحور حتى تصير الكفة منغمسة في الماء قهراً . وليفهم انه متى كان الوتد من السهم في غاية انخفاضه فانه منطبق مع وسط خرق المغرفة من أسفل الخرق ومتى دار المحور ربع دورة فان الوتد يصير في آخر الخرق عند دَ (وترتفع) (٦٤) المغرفة الى فوق . وعند تمام نصف دورة يصير (الوتد) (٦٥) في غاية ارتفاعه منطبقاً عليه وسط (خرق) (٦٦) المغرفة من فوق . وعند تمام ثلاثة أرباع دورة يصير الوتد في آخر خرق المغرفة عند بَ منحطاً بالمغرفة وعند تمام دورة كاملة يعود الوتد الى مكانه من وسط الخرق منطبقاً عليه (بحطه) (٦٧) الى أسفل (فتنغمس) (٦٨) الكفة في الماء . وذلك ما أردت إيضاحه جلياً .

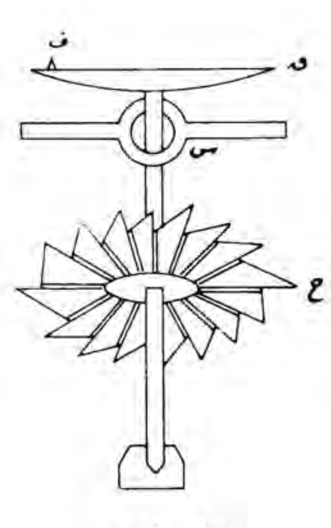
(٥٦) في مخطوطة اكسفورد وردت : (عليه) .
(٥٧) في مخطوطة اكسفورد وردت : (ثقب) .
(٥٨) في مخطوطتي اكسفورد و (٣٦٠٦) وردت : (صفيحة حديد) .
(٥٩) في مخطوطتي اكسفورد (و ٣٦٠٦) وردت : (صفيحة حديد) .
(٦٠) في مخطوطة اكسفورد وردت (سهم معارض لَ) .
(٦١) في مخطوطة اكسفورد وردت : (وسهم) .
(٦٢) في مخطوطة اكسفورد وردت : (الى خرق) .
(٦٣) في مخطوطتي (٤١٤) و (٣٦٠٦) وردت : (في غاية انحطاط) .
(٦٤) في مخطوطتي اكسفورد و (٣٦٠٦) وردت : (وترفع) .
(٦٥) في مخطوطة (٣٦٠٦) ينقص النص العبارة التالية : (في غاية ارتفاعه منطبقاً عليه وسط خرق المغرفة من فوق وعند تمام ثلاثة أرباع دورة يصير الوتد) .
(٦٦) في مخطوطة اكسفورد وردت : (حرف) .
(٦٧) في مخطوطة اكسفورد وردت : (نحطه) .
(٦٨) في مخطوطة (٣٤٧٢) وردت : (فتغمس) .

وأصف ما صنعته وهو آلة ترفع ماء نحواً من عشرين ذراعاً بدولاب في ماء جار .

الشكل الخامس من النوع الخامس

وهو آلة ترفع ماء نحواً من عشرين ذراعاً بدولاب من مـاء جـار وينقسم الى فصول ثلاثة :

الفصل الأول :

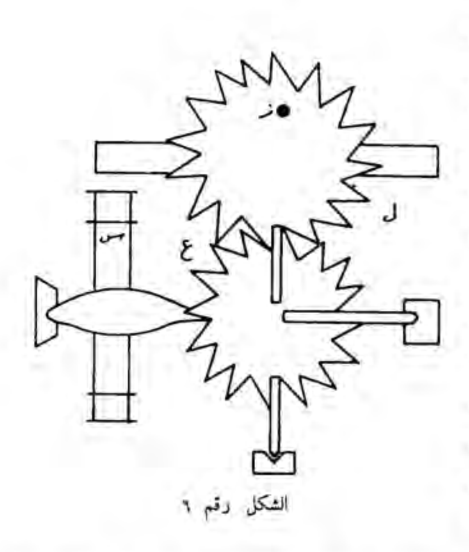


الشكل رقم ٥

أقول أن هذا الشكل يصنع على ضربين أحدهما بأن يتخذ (للدولاب) (٦٩) وهـو مدير الآلة (فرجات) (٧٠) في محور منتصب والماء يدير (الفرجات) (٧١) كالأرحاء ، وهي في (الطرف) (٧٢) الأسفل من المحور وهو يدور على سكرجة على ما جرت به العادة . وطرفه الأعلى يدور في حلقة ثابتة وعلى نهاية هذا الطرف قرص مستوى الوجه. وعلى حافة القرص وتد منتصب ، وهذا الوتد هو مدير آلة ترفع الماء . وأمثّل صورة (هذه) (٧٣) الفرجات وعليها القرص (وعليه) (٧٤) الوتد . وعلى الفرجات وهي موربات حَ وعلى الحلقة التي يدور فيها أعلى المحور سَ وعلى القرص من نهـاية رأس المحور قَ وعلى الوتد في جـانب القرص فَ .

الضرب الثاني انه يتخذ دولاب ذو أجنحة على طرف محور يوازي الأفق وبعض أجنحة منغمسة في ماء جار وعلى طرفه الآخر دولاب ذو دندانجات يدير بدورانه قرصاً على دايره دندانجات وعلى جانبه وتد منتصب يدير الآلة وأمثل صورة ذلك .وعلى دولاب الأجنحة سَ

(٦٩) في مخطوطتي اكسفورد و (٣٦٠٦) وردت : (الدولاب) .
(٧٠) في مخطوطة اكسفورد وردت : (فرخات) .
(٧١) في مخطوطة اكسفورد وردت : (الفرخات) .
(٧٢) في مخطوطة (٣٤٧٢) وردت : (طرف) .
(٧٣) في مخطوطة (٣٤٧٢) وردت : (هذا) .
(٧٤) في مخطوطة اكسفورد وردت : (عليها) .



الشكل رقم ٦

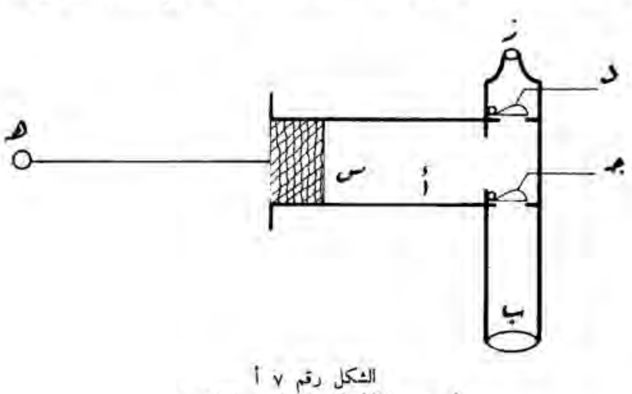
وعلى دولاب الدندانجات عَ وهو يدير قرصاً على أعلى محور طرفه الأسفل في (سكرجة) (٧٥) ودون طرفه الأعلى حلقة (يدور) (٧٦) فيها وعلى نهاية طرفه القرص وعليه لَ وعلى جانب القرص (وتد) (٧٧) منتصب يدير الآلة عليه زَ . وأما الآلة فيتخذ صندوق مثلث الشكل ضلعه نحو من ثمانية أشبار (وارتفاعه) (٧٨) شبران وليكن من خشب التوت وعلى (الزوايا) (٧٩) منه ح ع س ثم يتخذ دون أعلاه قرص على طرف محور والطرف الآخر من المحور في أرض الصندوق يدور على سكرجة . وتحت القرص حلقة يدور فيها المحور وعلى داير القرص دندانجات بارزات عن الصندوق وعلى القرص في داخل الصندوق وَ وعلى الدندانجات وهي خارجة عن جانب الصندوق (شَ) (٨٠) وعلى وجه القرص وتد منتصب عند حرفه . ثم يتخذ سهم في أحد طرفيه ثقب فيه مسمار ثابت عند زاوية عَ من الصندوق والطرف الآخر مخروق طولاً خرقاً طوله قطر دايرة (يوثرها) (٨١) راس وتد القرص وهو في الخرق ليصير الوتد في غاية (بعده) (٨٢) عن زاوية حَ من الصندوق في طرف(٨٣) الخرق . وعلى وسط الخرق شمالاً لَ وعلى وسط الخرق يميناً هَ (فاذن) (٨٤) سهم قَ لا ميل له الى جهة حَ ولا الى جهة سَ وهو بالحقيقة متوسط بينهما. ومتى دار قرص وَ من جهة حَ الى جهة سَ ربع دورة فان وتد القرص

(٧٥) في مخطوطة اكسفورد وردت : (أسكرجة) .
(٧٦) في مخطوطة اكسفورد وردت : (تدور) .
(٧٧) في مخطوطة اكسفورد وردت : (وهو) .
(٧٨) في مخطوطة (٣٤٧٢) وردت : (فارتفاعه) .
(٧٩) في مخطوطات اكسفورد و (٤١٤) و (٣٦٠٦) وردت : (الزاوية) .
(٨٠) في مخطوطتي اكسفورد و (٤١٤) وردت : (س) .
(٨١) في مخطوطة اكسفورد وردت : (يوترها) .
(٨٢) في مخطوطة اكسفورد وردت : (بعيدة) .
(٨٣) وردت هكذا في جميع النسخ .
(٨٤) في مخطوطة (و) وردت : (فاذا) .

يصير (الى) (٨٥) ناحية سَ ويميل معه سهم قَ وهو غاية ميله هناك وحركة قرص وَ دايمة حتى تدور ربع دورة ويصير الوتد الى جهة عَ وقد عاد السهم الى الوسط ومتى دار القرص ربع دورة أخرى صار الوتد الى جهة حَ وقد مال سهم قَ اليها وهو غاية ميله الى جهة حَ ومتى كملت دورة القرص عاد الوتد الى النقطة التي ابتدا منها وقد صار الوتد والسهم في الوسط .

الفصل الثاني :

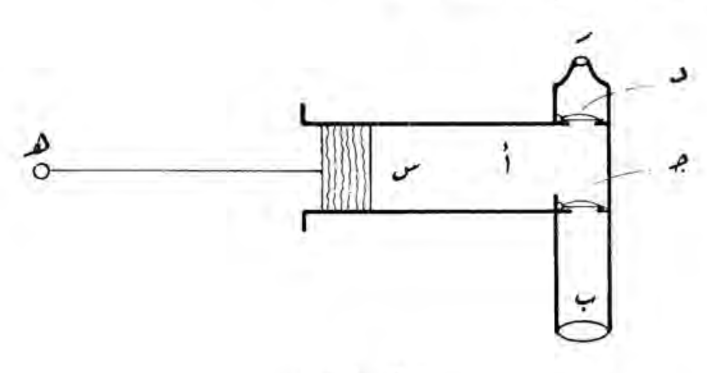
يتخذ بربخ من نحاس طوله قطر قرص وَ وغلظه سعة دايرة قطرها نحو من شبر (ويسد) (٨٦) أحد طرفيه ويفتح في جانبه دون طرفه المسدود خرق ويتخذ عليه أنبوب طوله شبر ونصف وعلى هذا الطرف الملصق بالبربخ صفيحة مستديرة خفيفة في حافتها نرماذجة متصلة بسداد (طرف) (٨٧) البربخ تتحرّك الى فوق فقط واسمها ردادة ثم يتخذ فيما يقابل هذا الأنبوب على طرف البربخ أيضاً خرق وعليه أنبوب غليظ ثم دقيق وعند مكان الصاقه بالبربخ ردادة أخرى تتحرّك أيضاً الى فوق فقط . ثم يتخذ قضيب من حديد طوله نحو من شبرين ونصف (وطرفه حلقة) (٨٨) وعلى الطرف الآخر قرصان هو داخل في ثقبي مركزيهما وبعد ما بين القرصين ثلاث أصابع مضمومات وسعة كل قرص ما يدخل في البربخ بسهولة ثم يلف فيما بين القرصين خيط من القنب لفة بعد لفة حتى يمتلي ما بين القرصين ويدخل هذا



الشكل رقم ٧ أ
(حسب المخطوطة رقم احمد الثالث)

(٨٥) في مخطوطة (أوكسفورد) وردت : (في) .
(٨٦) في مخطوطة (٣٦٠٦) وردت : (ويشد) .
(٨٧) في مخطوطة (٣٤٧٢) وردت : (بطرف) .
(٨٨) في مخطوطة (أوكسفورد) وردت : (حلقة) / وفي مخطوطة (٣٤٧٢) وردت : (طرفه حلقة).

الطرف بالقرصين في البربخ قهراً وينعم داخل البربخ ما أمكن ليسهل حركة القرصين والقنب فيه وأمثل صورة البربخ وما يتعلق به مفرداً .



الشكل رقم ٧ ب
(حسب المخطوطة رقم أيا صوفيا ٣٦٠٦)

فالبربخ وعليه أ وأنبوب في طرفه مفتوح عليه ب وفيه ردادة عليها جـ وهذا الأنبوب الى جهة أسفل (ويقابله) (٨٩) أنبوب من فوق وهو غليظ ويمتد الى فوق وهو دقيق ، وفيه ردادة عليها د وعمود حديد في طرفه حلقة عليها هـ وعلى الطرف الآخر قرصان بينهما خيط قنب وعليه س وهذه الآلة هي (زراقة) (٩٠) (كزراقات) (٩١) النفط إلا انها اعظم من تلك . ومتى وضع طرف أنبوب ب في الماء وجذب طرف القضيب وهو حلقة عليها هـ وتحرك القرصان والقنب الى طرف البربخ فان ردادة جـ ترتفع وتنطبق ردادة د والهواء يجذب الماء من أنبوب ب فيمتلي بربخ أ ماء ومتى دفع قضيب هـ انطبقت ردادة جـ وانبعث الماء ورفع ردادة د وصعد الماء بقوة في انبوب ز الدقيق الى فوق نحو عشرين ذراعاً وهو مسافة طول الأنبوب .

ثم يتخذ بربخ آخر بهذه الصفة المتقدمة (مما) (٩٢) يتعلق به وعلى البربخ ط وأنبوب عليه لا وفيه ردادة عليها ى ويقابله (من فوق) (٩٣) أنبوب غليظ ثم دقيق وفيه ردادة عليها ص. والقضيب وطرفه حلقة وعلى الطرف الآخر قرصان بينهما قنب وعليه ن وعند تحرير ذلك يخرق

(٨٩) في مخطوطة (٣٦٠٦) وردت : (ومقابله) .
(٩٠) في مخطوطة اكسفورد وردت : (زراقات) / وفي مخطوطة (٤١٤) وردت : (زرقات) .
(٩١) في مخطوطة (٣٤٧٢) وردت : (كزرقات) .
(٩٢) في مخطوطة (٤١٤) وردت : (بما) / في مخطوطة (٣٦٠٦) وردت : (ما) .
(٩٣) في مخطوطة (٤١٤) وردت : (فوق) .

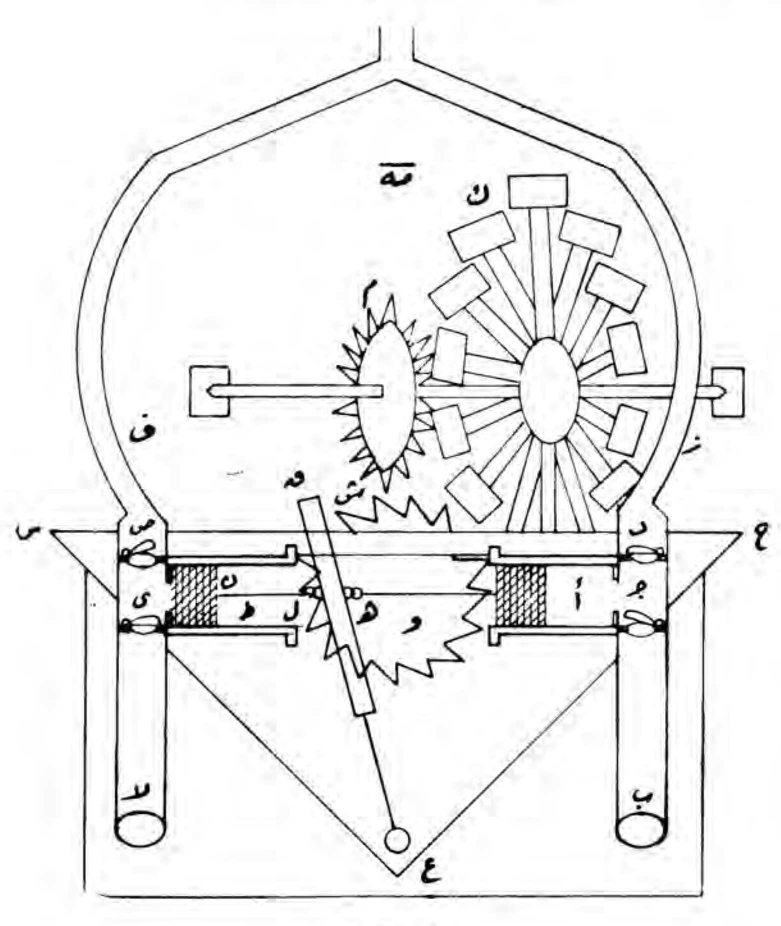
في أرض الصندوق من جهة ح خرق وينزل فيه أنبوب ب من بربخ أ الى حد نصفه ويوثق بحاله ويحمل بربخ أ على حمالات ثابتات ويوثق ويخرج أنبوب ز من أعلى الصندوق معوجاً الى جهة وسطه ويتخذ على وسط جانب خرق سهم ق عند نقطة ه رزة قد (اجيزت) (٩٤) في حلقة طرف قضيب ه وكذلك يركب البربخ الآخر في زاوية س من الصندوق ويتخذ عند وسط جانب خرق السهم رزة قد (اجيزت) (٩٥) في حلقة طرف قضيب ل . وقد تبين انه متى تحرك سهم ق يساراً اندفع الماء من بربخ ط في أنبوب ف وارتفع من أنبوب ب ماء الى بربخ أ ومتى عاد السهم يميناً اندفع الماء من بربخ أ في انبوب ز وارتفع في انبوب لا ماء الى بربخ ن .

الفصل الثالث :

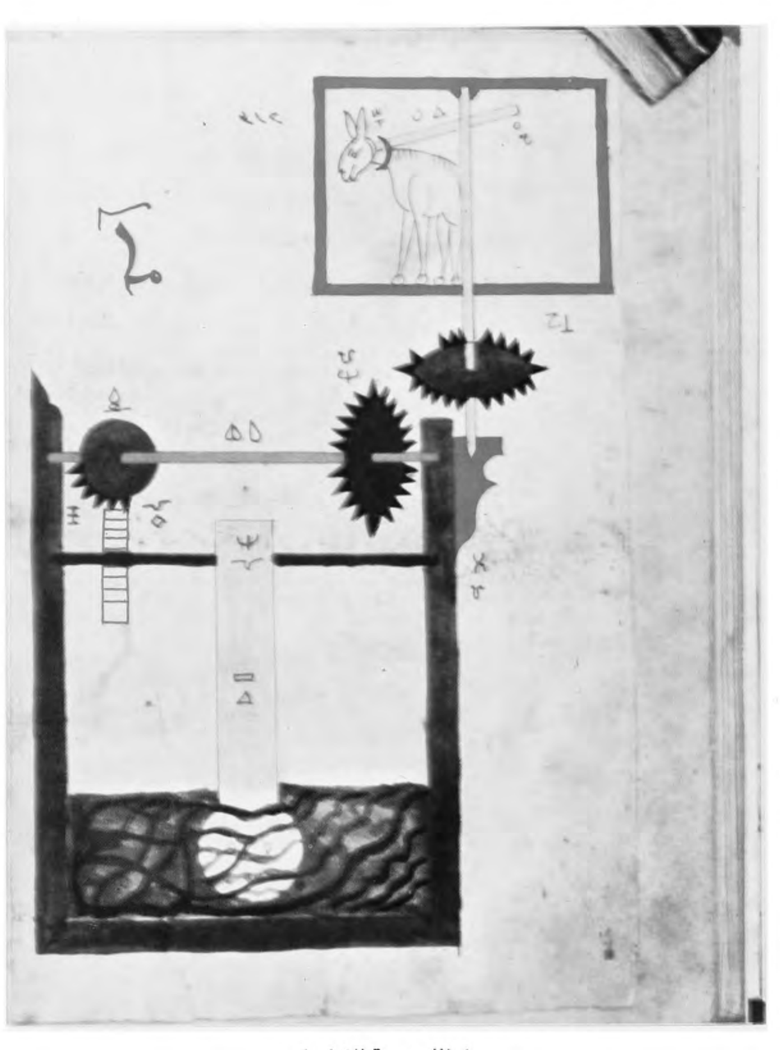
يتخذ دولاب ذو أجنحة عليه ك في طرف محور يوازي الأفق وعلى طرفه الآخر دولاب ذو دندانجات وهـــن بـــين دندانجات قرص و وعليه م . وأجنحة ك في ماء جار يديرها ، وطرفا محوره على ركنين ثابتين في النهر ثم يوضع الصندوق مما يلي دولاب م وأنبوبا ب لا منغمسان في الماء ويوثق الصندوق بحاله كيلا يتحرك البتة ويغطي رأسه بغطاء ويثقل عليه كيلا يتغير عن مكانه ويجمع بين طرفي انبوبي ز ف ويتخذ فوقهما أنبوب منتصب طوله نحو من عشرين ذراعاً وليكن دقيقاً ومن أعلاه يفور الماء الى الجهة المختارة . وأمثل صورة جميع ما ذكرته (مكملاً) (٩٦) .

فمن الواضح الجلي انه متى دار دولاب ك وعلى محوره دولاب م أدار دندانجات قرص و وعلى (وجهه) (٩٧) سهم ق وفي السهم خرق ه ل فيه الوتد المنتصب وفي جانبي الخرق رزتا ه ل وفيهما حلقتا طرفي قضيبي (الزراقتين) (٩٨) وبدوران قرص و يدور معه وتده (فيدير) سهم ق يمنة ويسرة ويدفع قضيب ه ويجذب قضيب ل بنصف دورة ثم يدفع قضيب ل ويجذب قضيب ه في تمام دورة وبالجذب يدخل الماء الى البربخ وبالدفع يندفع الماء في أنبوبي ز ف ويرتفع في أنبوب الوسط متصلاً بعضه ببعض . وردادة د تمنع الماء من الرجوع الى بربخ أ وردادة ص تمنع الماء من الرجوع الى بربخ ط وردادة ج تمنع الماء من (النزول) (٩٩) الى النهر في أنبوب ب وكذلك ردادة ى تمنعه من النزول الى (النهر) (١٠٠) في أنبوب لا وذلك ما أردت إيضاحه جلياً (١٠١) .

(٩٤) في مخطوطة اكسفورد وردت : (احترت) .
(٩٥) في مخطوطة اكسفورد وردت : (احترت) .
(٩٦) في مخطوطتي (٣٤٧٢ و ٤١٤) وردت : (كلا) .
(٩٧) في مخطوطة (٤١٤) وردت : (وجه) .
(٩٨) في مخطوطة (٣٤٧٢) وردت : (الزرافتين) .
(٩٩) في مخطوطة اكسفورد وردت : (الزوال) .
(١٠٠) في مخطوطة (٣٤٧٢) وردت : (نهر) .
(١٠١) في مخطوطة (٣٦٠٦) تنقص صفحة كاملة من النص كما ينقص الشكل الخامس من النوع الخامس

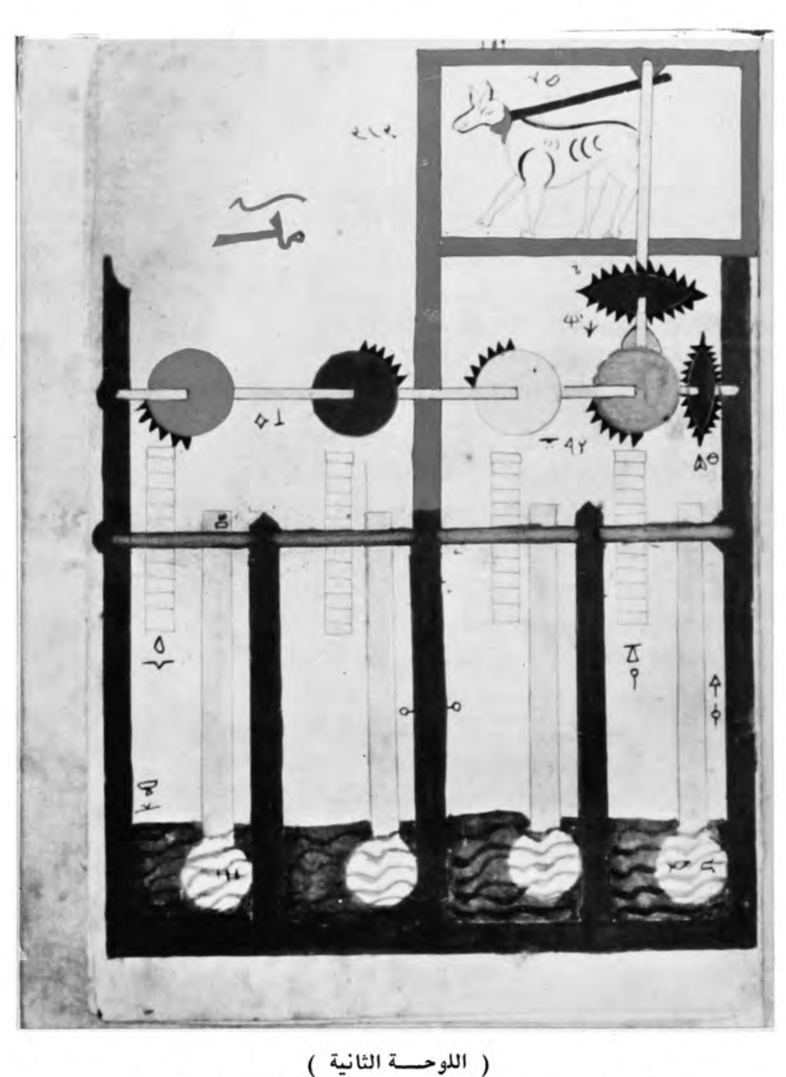


الشكل رقم ٨
(حسب المخطوطة رقم أحمد الثالث ٣٤٧٢)



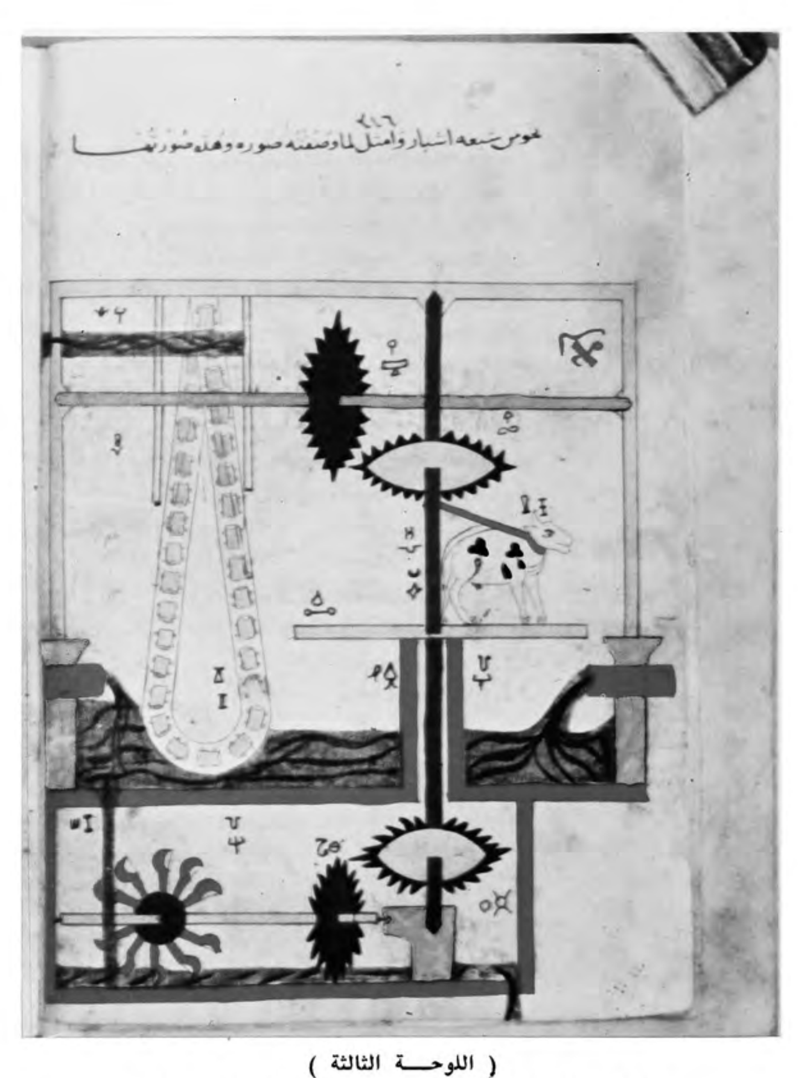
(اللوحـــة الاولى)

المضخة الاولى من مضخات الجزري وهي اللوحة مآ [٤١] من اللوحات
الخمسين الرئيسية ، عن المخطوطة طوبقابي سراي ٣٤٧٢



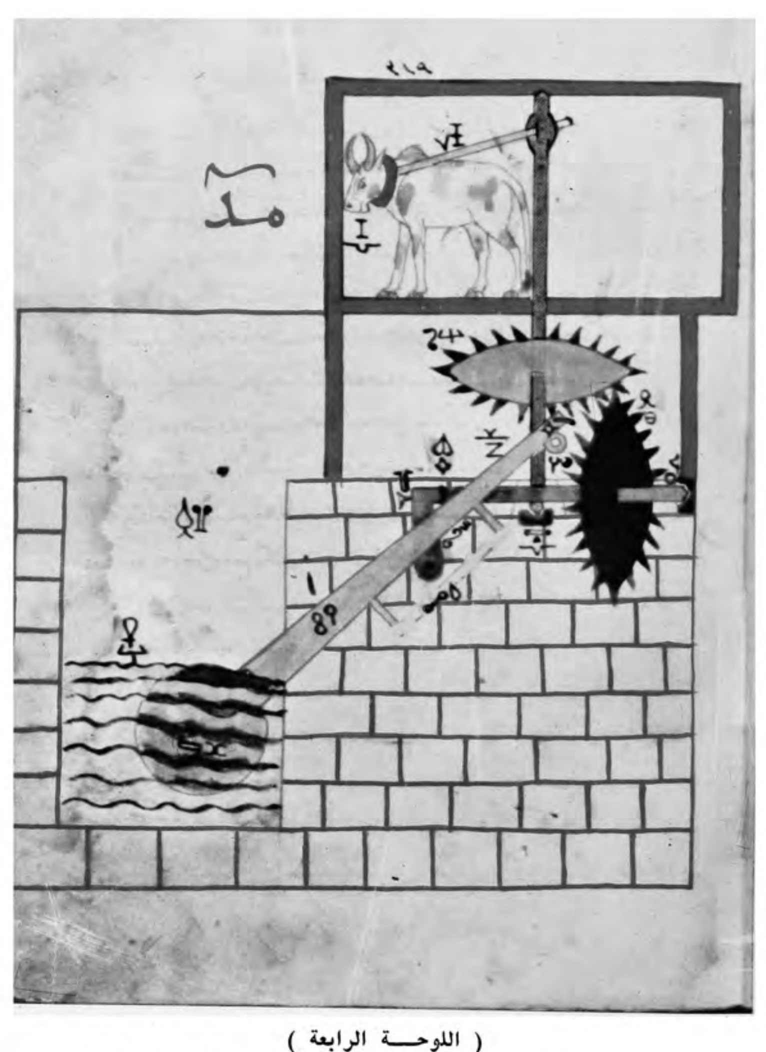
(اللوحـــة الثانية)

المضخة الثانية من مضخات الجزري وهي شبيهة بالاولى الا أنها باربع مغارف ٠ وهذه هي اللوحة مب [٤٢] من اللوحـــات الخمسين الرئيسية ٠ عـن المخطوطة طوبقابي سراي ٣٤٧٢



(اللوحــــة الثالثة)

المضخة الثالثة من مضخات الجزري · وهي اللوحة مج [٤٣] من اللوحات الخمسين الرئيسية ، عن المخطوطة طوبقابي سراي ٣٤٧٢



(اللوحـــة الرابعة)

المضخة الرابعة من مضخات الجزري • وهي اللوحة مد [٤٤] من اللوحات الخمسين الرئيسية • عن المخطوطة طوبقابي سراي ٣٤٧٢



(اللوحـــة الخامسة)

صفحة من المخطوطة طوبقابي سراي ٣٤٧٢ ، وهي تصور الطريقة الاولى من احدى طريقتين لتدوير المضخة الخامسة من مضخات الجزري

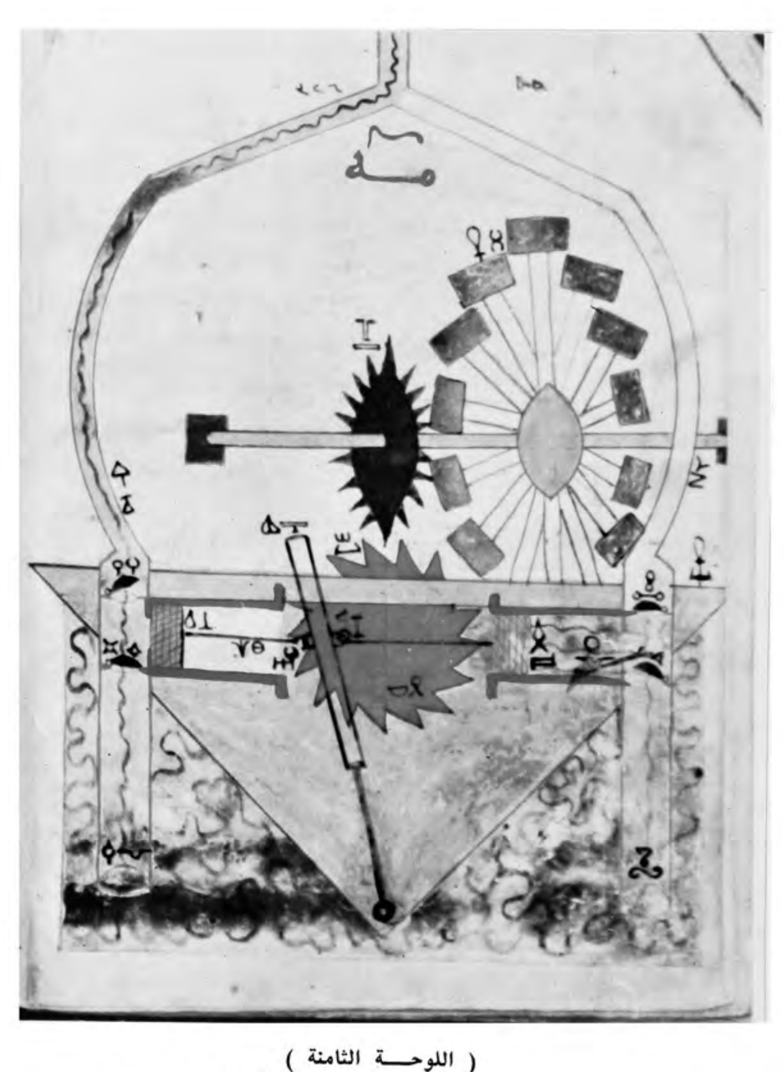
(اللوحـــة السادسة)

صفحة اخرى من المخطوطة طوبقابي سراي ٣٤٧٢ ، وهي تصور الطريقة الثانية من طرق تدوير المضغة الخامسة



(اللوحـــة السابعة)

صفحة من المخطوطة طوبقابي سراي ٣٤٧٢ ، وفيها تفصيل لاحد المكبسين مع الصمامات



(اللوحـــة الثامنة)

المضخة الخامسة من مضخات الجزري • وهي اللوحة مه [٤٥] من اللوحات
الخمسين الرئيسية • عن المخطوطة طوبقابي سراي ٣٤٧٢

تقرير الرازي حول الزكام المزمن عند تفتح الورد

تحقيق الدكتورة
فريدرون ر. هاو
معهد تاريخ الطب في بون

تمتع أكبر طبيب في فترة ازدهار الحضارة الإسلامية ، محمد بن زكريا الرازي (باللاتينية "Rhazes") [1] بشهرة عظيمة في العصر اللاتيني الوسيط بفضل مؤلفه الضخم «كتــاب الحاوي» (باللاتينية "*Liber Continens*") ، ثم بالكتاب التاسع من «كتاب المنصوري» ، وهو ما يطلق عليه باللاتينية اسم "*Nonus Almansoris*" الذي يعالج علم الأمراض الخاص ، وكذلك وبوجه خاص بفضل تصنيفه الصغير «كتاب الجدري والحصبة» (باللاتينية "*De Variolis et Morbillis*") .

وهناك تقرير يكاد يكون مجهولاً وضعه الرازي لمعلمه في الفلسفة ، أبي زيد أحمد بن سهل البلخي [2] ، الذي كان يعاني كل سنة عند موسم تفتح الورد من الزكام . وغرضنا نشر هذا التقرير في الصفحات التالية . لم يعرف التقرير كمؤلف مستقل ، بل أورده ابن سرابيون بن ابراهيم فقط في كتابه الوحيد «الفصول المهمة في طب الأمة» . والكتاب المذكور لا توجد منه إلا نسخة واحدة فقط ، وهي نسخة غير كاملة مـن الكتاب . أما المؤلف فمجهول لا يعرف عنه شيء . ولكن نظراً لإشارة ابن سرابيون بن إبراهيم إلى ابن سينا (المتوفى ٤٢٨هـ / ١٠٣٧م) ، فمن المتعذر أن يكون التقرير قد صنف قبل النصف الثاني من القرن الحادي عشر . ويوجد تقرير الرازي هذا في

(١) ابن النديم : الفهرست ، مصر ١٣٤٨ هـ ، ص ٤١٥، ١٩-٤٢٠، ١ ؛ ابن جلجل : طبقات الأطباء والحكماء ، القاهرة ١٩٥٥ ، ص ٧٧-٨٠ (رقم ٢٨) ؛ ابن القفطي : تأريخ الحكاء ، نشر يوليوس ليبرت ، لايبزغ ١٩٠٣ ، ص ٢٧١ ، ١٣-٢٧٧، ٧ ؛ ابن أبي أصيبعة : كتاب عيون الأنباء في طبقات الأطباء ، نشر آوغوست مولر ، المجلد ٢/١ ، كونغزبيرغ ، القاهرة ١٨٨٢-١٨٨٤ ، المجلد ١ ، ص ٣٠٩، ١٦ - ٣٢١، ٢٠ ؛
Carl Brockelmann: *GAL (Geschichte der arabischen Litteratur)* I 233, SI 417 ff.; Fuat Sezgin: *GAS (Geschichte des arabischen Schrifttums)* III, 274 - 288; *Enzyklopaedie des Islam*. Leiden, Leipzig: Brill, Harrassowitz, Band III (1936), Sp. 1225 a — 1227 b.

(٢) ابن النديم : الفهرست ، مصر ١٣٤٨ هـ ، ص ١٩٨، ٥-١٩٩، ٩ ؛ راجع ابن أبي أصيبعة ، مجلد ١ ، ص ٣١٥ - ٨ ؛
Fuat Sezgin: *GAS* III, S. 274; Carl Brockelmann: *GAL* I 299, S 1 408

مجموعــة مخطوطــات *Codex Huntingtonianus* في اكسفورد تحت رقــم 461 الأوراق (78 b,—3 حتّى 80 b,8). وللتدليل على صحة تقرير الرازي فــان البيروني (المتوفى ٤٤٠هـ / ١٠٤٨م) هو أقدم مصدر يمكن الإشارة إليه . فقد وضع البــيروني حسب معلوماته الخاصة رسالة أورد فيهــا فهرست أعمال الرازي [٣] جــاء فيها تحت الرقم 38 [٤]: في النزلة كانت تعتري أبا زيد <وقت الورد> وفيما عدا ذلك لا يأتي أحد على ذكر تقرير الرازي إلا ابن أبي أصيبعة [٥] في مؤلفه «كتاب عيون الأنباء في طبقات الأطباء» [٦] وذلك كما يلي: مقالة في العلة التي من أجلها يعرض الزكام لأبي زيد البلخي في فصل الربيع عند شمه الورد [٧] .

وفي ترجمة محمد بن زكريا الرازي نوجز كما يلي : وُلد عام ٢٥١هـ / ٨٦٥م في الري [٨] . واشتغل في مسقط رأسه في الموسيقى والأدب والفلسفة والسيمياء . ويقال إنه لم يبدأ دراسة الطب إلا بعد بلوغه الثلاثين . وقد كلّف في الري ثم في بغداد فيما بعد بادارة المستشفيات . وبعد ذلك بدأ سلسلة رحلاته . ثم عمي بصره في سن الشيخوخة ، وتوفي في ٣١٣ هـ / ٩٢٥ م .

أما معلم الرازي في الفلسفة ، البلخي ، الذي وضع التقرير من أجله فهو على الأغلب نفس أبي زيد أحمد بن سهــل البلخي [٩] ، الــذي ولد عام٢٣٦ هـ / ٨٥٠ م في شامستيان ، وهي قرية قريبة من بلخ في خراسان . ويشتهر البلخي اليوم بالدرجة الأولى بسبب مؤلفه الجغرافي «صور الأقاليم» الذي كان المصدر الأصلي الذي اعتمد عليه الإصطخري وابن حوقل والذي أصبح بفضل ذلك حجر الأساس لما يدعى بالمدرسة الكلاسيكية للجغرافيا العربية . وكان البلخي قد درس في العراق الفلسفة والتنجيم وعلم الفلك والطب والعلوم الطبيعية ، وتوفي عام ٣٢٢ هـ / ٩٣٤ م .

(٣) راجع باول كراوس Paul Kraus : رسالة للبيروني في فهرست كتب محمد بن زكريا الرازي ، باريس : مطبعة القلم ١٩٣٦ ، ص ٢، ١١–١٣ ؛ راجع يوليوس روسكا
Julius Ruska: Al-Bīrunī als Quelle für das Leben und die Schriften al-Rāzī's.
في مجلة : *ISIS* 5 (1923). p. 29 . أ. زكي اسكندر: الرازي ومهنة الطبيب . في «المشرق» المجلد ٥٤ (١٩٦٠) ص ٤٧٣ .

(٤) باول كراوس ، أعلاه ، ص ٩، ٢ ؛ روسكا ، أعلاه ، ص ٣٧ :
"Über die Atemnot, die den Abū Zayd (zur Zeit der Rosen) zu befallen pflegte".

(٥) توفي عام ٦٤٦ هـ/١٢٧٠

(٦) نشر آوغوست موللر August Müller ، كونغزبيرغ ، القاهرة ١٨٨٢–١٨٨٤ ، المجلد ١، ٢ .

(٧) ابن أبي أصيبعة ، اعلاه ، ص ٣١٩ ، ١٩ — ٢٠ .

(٨) راجع التعليق (١) .

(٩) راجع التعليق .(٢) .

بسم الله الرحمن الرحيم

[ق ٧٨ ب] كتب شهيد بن الحسين البلخي الى محمّد ابن زكريا الرازي يسأله (١) عن علّة أبي زيد أحمد بن سهل البلخي الكاتب فأجابه : فهمتُ ما ذكرتَ من وصف العلّة التي تعتاد شيخَنا . [ق ٧٩ أ]* أبا زيد والكلامُ في سببها ولِمَ تُهاج في فصلِ الربيعِ خاصّةً وصارَ شمُّ الورد يُهيّجُها بطولٍ ولذلك اقتصرتُ على ذكر ما يحتاجُ اليه في الاحتراس منها ومعالجتها اذا كانت فأقولُ إنه ينبغي أن يتوقّى(٢) ما يملأ الرأس ومن النوم (٣) بعقَب الطعام سريعاً لاسيّما بعد شُرب ماء باردٍ كثير والمراقدَ التي (هو) فيها كثيرُ الرطوبة والبخارِ الغليظ كالحُبُوسِ (٤) والأسراب والبيوتِ النديّة (٥) والنزهةَ وكشفِ الرأس للهواء البارد لاسيما مع تبريد(٦) البدنِ وامتلاءِه من الطعام والشراب وكثرةَ الكلام والصياحِ وطولَ الفكر(٧) وضيقَ الزرّ على العنُقِ ولطيِّ (٨) الوسادة عند النومِ وكثرةَ صبِّ الماء البارد على الرأس وتطويلِ الشعَر والإدهان لا سيّما بالأدهان القابضة واستعمالات الخضابات القابضة والتواتُرفي ذلك الرأس ومشْطه وشمّ الأشياء التي يَنحلُّ منها أبخرةٌ كثيرة جداً كالورد والشاهَسْفَرَم فانهما في غايةِ اللطافة وكذلك شمُّ الأشياء التي تُعطِّس اذا استُعْمِلَتْ مع امتلاء البدنِ والبطنِ وكذلك الأشياء التي تُثقِّلُ الرأس وتُسبِت كاللُّفّاح والميْعةِ والزعفرانِ والتي يَكثُرُ تبخيرُها كالباقلّي والسّمكِ والفراخ والبصل والكُراث والثُّومِ والجرجير والشرابِ ويتعاهدُ مع ذلك ما يُخفّف عن الرأسِ كالنُّقْص القويّ (في وزن الجسم) في أوائل الربيع ووسطه والأشياء(٩) المُخرجةِ للرطوبة (١٠) المُجتمعةِ في فصلِ الشتاء في البدنِ لفرْط

(١) في الاصل : يسله
(٢) في الاصل : يتوقا
(٣) كذا في الاصل : وما يملا من النوم
(٤) في الاصل : كالحيوش ولعل الاصح : كالحبوس
(٥) هذه الكلمة ناقصة في الاصل
(٦) في الاصل : تدبير البدن
(٧) في الاصل : للفكر
(٨) في الاصل : لطا
(٩) هذه الكلمة ناقصة في الاصل
(١٠) في الاصل : الرطوبة
(*) بداية ق (٧٩) أ

التملّوء (١١) من الطعام والشراب وطول النوم في البيوت الغليظة الهواء الكثيرة الأبخرة والدُّخان لثُقْل مــوادّ الأبخرة الصاعدة الى الرأس . [ق ٧٩ ب] والنوم على القفا ويُجتَذَبُ العُطاسُ بادخال سَحاة في أنفه لتجذبَ (١٢) المادّة نحــو أنفه ويستَثير ويمْخُطُ مرات كثيرةً وانْكبّ على بُخار الماء المطبوخ فيــه البابونَج والنمّام والفوتَنَج والشّيحُ ونحوها فانّ هذه تجتَذِبُ الموادّ الى الأنف وتُنضج (١٣) بعضاً وتُحلّلُ بعضاً وتُستعمَلُ قبل النوم الأشياء المانعة من نزول المادّة الى الصدر فانها تنزلُ الى الصدر عند الاستغراق في النوم لاسيما ان كان مُستلقياً وطالَ به ذلك فان (١٤) نزولها الى الصدر يُثير (١٥) البُحوحة والسعالَ وضيقَ النفس والحمّى وان كانت كثيرةً وحينئذ ينبغي ان تكون العنايةُ تنضيجَ ما قد نزل الى الصدر منها وتَنفيثَها بأدوية مُحلّلة مثلَ طَبيخ الزّوفا ليُليّنَ الصدرُ ثم يُنقّيه بسهولة لئلاّ تجذبُ من شدّة السعالِ على الرئة حادثةٌ ومنْعُ ما لم ينزل ودفعُ مادّة ما يصْعد الى الرأس وتحليلُ ما قد صعدَ ويكون بتدليكه (١٦) على خواء من البدن وتكميده كذلك وان خيفَ على النّغانغ من كثرة المادّة حلقَ الرأسُ وطُلي بالخردل وعُصارة العُنصُل ونحوهما ممّا يَنْفُضُ (١٧) ويفُوح ويجرّها الى الأنف بالعطاس وإشمام الأشياء الحارّة كالشّونيز والبصل والخردل وغيرها وبالتّغرغُر بما يقوّي عضلَ الحنجرة ولا يحشو (١٨) كالماء البارد والماورد ويتجرّع دائماً (١٩) ما شأنُه مَنعُ النوازلَ مثل شراب الخشخاش والأدوية واللّعُوقات المتخذة من الخشخاش والكثيرا والصّمْغ ولُعاب حبّ السفرجل والبزْرقَطونا وعُصارة بقْلة الحمقاء وعنب الثّعلب وان أقلقَ السّعالُ فالأدوية المُتّخذة من الأفيون والبنْج والكُنْدُر والطّين الأرْمنيّ وأمّا نضْجُ ما نزل [ق ٨٠ أ] الى الصدر فيكونُ

(١١) في الاصل : التملى
(١٢) في الاصل : ليجذب
(١٣) في الاصل : وانضج
(١٤) في الاصل : وانه
(١٥) هذه الكلمة ناقصة في الأصل
(١٦) في الاصل : بيدلبه
(١٧) في الاصل : « نعط وتفرح »
(١٨) في الاصل : يخشى مع هذه الحاشية « يخشن »
(١٩) في الاصل : دايما

بالمَرْخ بالقيروطي المتّخذ بـدهن الخيري أو دهن البابونج والتدبير والتكميد من بعد المرخ بخرق مسخنة ولزوم بيت كبير لا ينشق فيه هـواء بارد أو ينطله بالماء الحار والحمّام اللّيّن الكثير البخارة وأما نفثه بسهولة فيكون بجودة النّضج وصحة القـوة والأدوية التي تجلو أو التي تقطع كماء الشعير وماء السكّر والعسل وطبيخ التّين والزبيب وأصل السوس وبرسياوشان ودوام الغرغرة بالماء الحار وان اشتدّ الأمر استعملت الأدوية المتخذة بالحلبة والفراسيون والأنجرة والإيرسا والفلفل والخردل وغير ذلك. وأمّا من كان كثر (٢٠) تأذيه من هذه العلّة بانسداد المنخرين وحكّتهما وكثرة العطاس وسيلان الأنف فليستعمل (٢١) شبه الأشياء المذكورة والمشي والتعرّق في الحمام وحجامة النقرة وقد برأ غير واحد منهم ببتر شرياني الصدغين وسليما وبفصد عرق الجبهة وهو لا يمتلىء هذا الشريان منهم وسائر عروق الجبهة وينبضان الى العظم وتشتد حمرة الوجه منهم وحرارته وأمّا من يكون هذه الدلائل فيه أقلّ بل تكون حمرة الوجه وسخونته وقليل من امتلاء العروق فعقر الأذن أنفع لهم وكذلك تناول ما يغلّظ الدم ويبرّده كالخلّ والعدس والحصرم والريباس (٢٢) وربما يبرّد اليافوخ بالخلّ ودهن الورد المبرّدين اذا وضع على اليافوخ مرات كثيرة وقد تعمدت لقطع ثلج ووضعتها على يافوخ رجل كان في مجلس شراب فثار منه ضربة شيء عجيب وسكن عنه. [ق ٨٠ ب] جميع ما وجده بعد أن أحسّ ببرد شديد وقد وصل الى قعر رأسه فأعقبه ذلك نزلة خفيفة (٢٣) ليلته تلك وكان فيما بعد يتعالج بهذا العلاج إلاّ أنه لم يبرأ منها بواحدة وكان ينتفع بالإسهال العنيف المنفعة العظيمة وكذلك بالمشي والصوم وأخشب هؤلاء هم الذين خلقة الأوداج فيهم عظيمة جداً والذين يكثر تأذيهم لشمّ الورد فينفعهم شمّ المسك والقسط والمرّ وتمسح داخل الأنف بالبان والسوسن واستنشاق بهمـا إن شاء الله تعالى تمت الرسالة والحمد لله وحده وصلّى الله على خير خلقه محمد المصطفى وآله وصحبه وسلّم كثيراً.

(٢٠) في الاصل : اكثر
(٢١) في الاصل : وسلم
(٢٢) كذا في الاصل : والريباس والريباس
(٢٣) في الاصل : خفية

«SUMMARY» of Taqrīr al-Rāzī ḥawl al-Zukām al-Muzmin, ʿind Tafattuḥ al-Ward

Edition of the Arabic Text by
FRIEDRUN R. HAU

Muḥammad ibn Zakarīyā al-Rāzī (latinized as Rhazes; 251/865-313/925) is considered to be one of the outstanding physicians in the golden age of Islamic civilization. A short treatise representing a medical opinion for his former teacher of philosophy Abū Zayd Aḥmad ibn Sahl al-Balkhi (236/850-322/934) has remained almost unknown. Cyril Elgood in his paper "Persian Science" (in: *The Legacy of Persia*. Ed. by A. J. Arberry. Oxford 1953, p. 315) remarks:"...Rhazes, who wrote a book, now lost, which he called "A Dissertation on the Cause of the Coryza which occurs in the Spring when Roses give forth their Scent".

In his exhaustive Habilitation thesis dealing with the history of allergy (University of Freiburg i. Breisgau* 1961) Hans Schadewaldt evaluates the present treatise as follows: "Erst der Islam scheint uns die erste Mitteilung über ein diesbezügliches Krankheitsbild geschenkt zu haben: den sogenannten "Rosenschnupfen"... in einer verloren gegangenen Schrift ...".

Besides the fact that this Medical Opinion represents the first clear description of an allergic cold, two other aspects are of interest to the medical historian.

1. In addition to the usual sweating cures Rāzī recommends arteriotomy in the temporal area, a procedure already mentioned by Galen.

2. He prescribes the cupping of the posterior region of the neck, a measure also recommended by Paul of Aegina in the third of his seven books.

Two Arabic manuscripts, one in India (Hyderabad) the other one in Persia (in private possession), were unfortunately unavailable to me. The basis of the present edition is the text preserved in the only extant work "al-Fuṣūl al-muhimma fī ṭibb al-umma" of the otherwise unknown Ibn Sarābiyūn ibn Ibrāhīm who compiled earlier writings. This text of the Medical Opinion of Rāzī is to be found in the Oxford codex Huntingtonianus 461 (foll. 78b3-80b8)[1]. As Ibn Sarābīyūn ibn Ibrāhīm quotes Avicenna (died 428/1037) his life span cannot be dated prior to the middle of the eleventh century.

1. The German translation with many annotations was published in "*Medizinhistorisches Journal*" 1975, Vol. 10, No. 2, pp. 94-102.

تعليق على
رسالة الرازي في الزكام

الدكتور سلمان قطاية
كلية الطب ـ جامعة حلب

نجد في هذا العدد تحقيقا دقيقا للدكتورة هاو لرسالة الرازي عن علة أبي زيد البلخي وهي الزكام المزمن الذي يظهر كل ربيع حين ازدهار الورود . وكانت قد ذكرت أولا في الفهرست لابن النديم تحت عنوان : « كتاب في العلة التي لها يحدث الورم من الزكام في رؤوس بعض الناس » . ولم تتناول الدكتورة الناحية السريرية والعلاجية عمدا ، لذا فقد وجدنا من المفيد ان نكمل الموضوع وذلك بتكليف كاتب التعليق بالقيام بهذه المهمة نظرا للقيمة الكبرى التي تتمتع بها هذه الرسالة وتتمة لعمل الدكتورة هاو المشكور .

تتمتع رسالة أبي بكر الرازي عن علة أبي زيد البلخي الذي يصيبه الزكام في الربيع حين شم الورود ، بأهمية خاصة .

فلربما كانت ، ولأول مرة في تاريخ الطب ، الرسالة الوحيدة المكرّسة بكاملها لدراسة هذه الظاهرة . ولنلاحظ منذ البداية الربط التام بين عناصر ثلاث : الزكام ، والربيع ، وشم الورود .

ونجد في هذا الربط التعريف السببي Aetiology لما نسميه اليوم بالرشح التحسسي أو الأرجي Allergic Coryza وتشمل هذه التسمية الحديثة على أشكال سريرية مختلفة ، والشكل الموصوف في رسالة الرازي هو المسمى رشح أو زكام العلف Hay Fever أو الرشح التشنجي الفصلي Vasomotor Rhinitis أو داء غبار الطلع Pollinosis .

ويظهر هذا الداء في فصل الربيع حين تتفتح الزهور فتملأ الجو بغبار الطلع الذي يدخل بتماس مباشر مع مخاطية الأنف فيسبب هذا النوع الخاص من الزكام . وقد يبدأ في فصل الصيف أحياناً وهذا عائد الى نوعية الأشجار والنباتات التي تنمو في المنطقة وموعد تفتح زهورها وحساسية المريض لها . وتتكرّر الهجمات في كل فصل وقد تخف حدتها مع الزمن لكنها لا تلبث أن تتحوّل الى شكل مزمن ، خاصة اذا أصيب المريض بانتان ثانوي وهو ما يحدث في معظم الحالات ؛ لأن الأرج هو المهد المفضل للجراثيم . ولا يصيب هذا الداء الا الأشخاص الذين لديهم استعداد وراثي أو شخصي لذلك .

ويتصف زكام العلف بثلاثة أعراض واضحة عنيفة ملفتة للنظر :

١– العطاس المتكرر الشديد وقد يصل الى ٤٠ أو ٥٠ مرة في اليوم .

٢– السيلان الأنفي المصلي الغزير الذي يملأ مناديل كثيرة .

٣– انسداد المنخرين بالاضافة الى أعراض اخرى كاحتقان العينين ، والهرب من الضوء ، والحكة في الفم والحلق والأنف ، والترفع الحراري ، والوهن الشديد .

ويسرد الرازي في رسالته الأعراض هذه كلها تقريباً فيقول : «انسداد المنخرين وحكتهما وكثرة العطاس وسيلان الأنف».ثم يذكر في موضع آخر أنه «تشتد حمرة الوجه فيهم وحرارته» . ويذكر أيضاً بعض ما يعانيه المرضى من كثرة السيلان ليلاً فيقول : «والنوم على القفا يسبب نزول المادة الى الصدر فانها تنزل الى الصدرعند الاستغراق في النوم لاسيما اذا كان مستلقياً وطال به ذلك فان نزولها الى الصدر يثير البحوحة وضيق النفس والحمى» . وبامكاننا هنا أن نميل الى الظن بأن هذه الأعراض الأخيرة أي بحوحة الصوت والسعال والزلة Dyspnea والحمى ليست سوى أعراض لشكل سريري حاد جداً وهو المصطحب بارتكاس Reaction لكل مخاطية الطرق التنفسية السفلى ، كالحنجرة والرغامى والقصبات ، أي بالشكل المصطحب بهجمة ربو أيضاً ، وهو شكل يصادف في بعض الأحيان وقد يشتد حتى يصل الى نوع من الانسمام الداخلي وقد يودي بحياة المريض .

ونلحظ في الرسالة أن حالة أبي زيد البلخي ليست الأولى أو الوحيدة التي صادفها وعالجها الرازي فيقول في عبارات متفرقة نقتبسها هنا: «أما من كثر تأذيه من هذه العلة ... وقد برأ منهم غير واحد ... وأما من تكون هذه الدلائل فيه . . وقد تعمدت بقطع ثلج ووضعتها على يافوخ رجل ... أما الذي يكثر تأذيهم لشم الورود ...» الخ .

كان قصد المؤلف من هذه الرسالة هو الجواب على السؤال الذي طرح عليه بشأن معالجة هذه العلة ، وبصدد هذا فهو يعمد الى تقسيم المعالجة الى وقائية وشفائية فيقول : «اقتصرت على ذكر مايحتاج اليه في الاحتراس منها ، ومعالجتها اذا كانت . » وفي الوقاية يقدم نصائح كثيرة متضاربة كالاحتراس من «كشف الرأس للهواء البارد» و «شرب ماء بارد كثير» وايضاً « كثر صب الماء البارد على الرأس» ، وهي أسباب الزكام أو الرشح العادي ، وليست سبباً للزكام الأرجي . فاذا انتقلنا الى المعالجة الشفائية وجدنا أيضاً وصفات كثيرة ومتضاربة كَدَهْنِ « اليافوخ بالخل ودُهن الورد المبردين » و« وضع قطع ثلج على اليافوخ » و «المشي والصوم » و « شم المسك والقسط (١) والمر » و «الاسهال العنيف» .

(١) Elecampane

ويذكر الرازي بعض المعالجات الخاصة كقوله : «يجتذب العطاس بادخال سحاة(٢) في أنفه لتجذب المادة نحو أنفه ويستثير ويمخط مرات كثيرة» وقوله : «حلق الرأس وطلي بالخردل والعنصل (٣) ونحوهما و «وقد برئ غير واحد منهم ببتر شرياني الصدغين سليماً وبفصد عرق الجبهة» و «عقر الأذن» (٤) .

ولكن سبب هذا التنوع في الوصفات والمعالجات هو كون الداء نفسه صعب المعالجة ، وهي قاعدة معروفة في الطب فمتى كثرت المعالجات قلت نسبة الشفاء ودلت على ضعف نجاح الأدوية الموصوفة . ولا عجب في ذلك ، اذ أننا لا زلنا حتى يومنا هذا ، ورغم التقدم الهائل في ميدان الجراحة والمعالجة الدوائية ، نشكو من صعوبة معالجة هذا الداء ، ونقرأ كل يوم عن دواء أو طريقة جديدة لشفائه . وآخر ما ذكر هو المداخلة الجراحية على عصب القناة الجناحية Vidian Nerve لقصه في الطرفين ويدعي المدافعون عن هذه الطريقة انها تتكلل بالنجاح .

فلا عجب اذن أن يسرد الرازي في مطلع القرن العاشر الميلادي قائمة مذهلة من الوصفات الطبية بل ان يؤكد ان أكثر من مريض قد برئ ببتر الشريان الصدغي Temporal Artery . وعلى كل حال فبامكاننا الإشارة الى ان الرازي قد لاحظ بالتجربة والاستقراء ، على أن ثمة أرج ناجم عن شم الروائح الشديدة لذا فهو يوصي بمنع : « شم الأشياء التي ينحل منها ابخرة كثيرة جداً كالورد والشاهسفرم (٥) .. وكذلك شم الأشياء التي تعطس ... وكذلك الأشياء التي تثقل الرأس وتسبت » .

ويشير الرازي الى أرج آخر ناجم عن تناول بعض الأطعمة التي « يكثر تبخرها كالباقلي والسمك والفراخ والبصل والثوم والجرجير» . ومن بين ما يصفه نجد الكثير مما نسميه اليوم بالمعالجة العرضية Symptomatic treatment فينصح باستعمال التبخيرة (٦) اذ يقول : «وانكب على بخار الماء المطبوخ فيه البابونج والنمام(٧) والفوتنج(٨) والشيح(٩) ونحوها فان هذه تجتذب المواد الى الأنف وتنضج بعضاً وتحلل بعضاً » وهي طريقة مستعملة حتى هذا اليوم . وينصح بايقاف السعال فيقول : «ان أقلق السعال فالأدوية المتخذة من الأفيون والبنج(١٠) والكندر(١١) والطين الأرمني» ولمعالجة التهاب القصبات يقول : «وأما نضج ما

(٢) ربما كانت سحاة Raspatory
(٣) Scilla - Urginea
(٤) Scarification
(٥) Ocomum Minimum
(٦) Inhalation
(٧) Thymus
(٨) Mentha pulegium
(٩) Abseutium Valgare
(١٠) Hyoscyamus
(١١) Boswellia Corterii

نزل الى الصدر فيكون بالمرخ القيروطي المتخذ بدهن الخيري اودهن البابونج ، والتدبير والتكميد من بعد المرخ بخرق مسخنة .. أو ينطله بالماء الحار والحمام اللين الكثير البخار . »

ولا بدّ لنا هنا من ان نتعرّض للمشاهدة رقم (٢٩) من مشاهدات الرازي الّتي نشرها مايرهوف(١٢) يقول : «ابن الحسن بن عبد ربه كان يصيبه أغلظما يكون من الزكام وأشده، رأيت مثله وما هو أقل منه يبقى على من يصيبه الشهر والأكثر «وينزل» الى صدره حتّى ينفثه بالسعال فكان يسكن عنه في نصف اليوم حتّى لا يجد شيئاً منه البتة ويهيج به وجع المفاصل» .

ولقد شخّصها مايرهوف على أنها حمى العلف اختلطت برثية مفصلية Rhumatism ولكن حمى العلف كما ذكرنا ، إصابة أرجية وأعراضها لا تنطبق في رأينا ، على الوصف المذكور في هذه المشاهدة ولكننا نعتقد أنهـا عبارة عن التهاب جيوب حاد مترافق مع نزلة والتهاب قصبات قد اختلط بالتهاب مفاصل .

بينما تختلف رسالة الرازي حول علة أبي زيد البلخي اختلافاً تاماً عما نعرفه اليوم فالتشخيص فيها واضح لا ريب فيه .

ومن خلال هذه المقالة المقتضبة نستطيع القول ان شرف وصف هذا الداء ولأول مرة في التاريخ قد يعود الى ابي بكر الرازي .

Commentaire de l'Epître de Rhazes à propos de la Rhinite Allergique (Resumé)

Salman Katayé

Nous publions dans ce numéro de notre revue, pour la première fois, et grâce au Dr. Hau, le texte intégral de la lettre d'Abū Bakr al-Rāzī concernant la maladie de l'écrivain Abū Zayd Aḥmad Ibn Sahl al-Balkhī. Cette maladie est un coryza chronique apparaissant au printemps au moment de la floraison des roses.

La description minutieuse des symptômes ne laisse aucun doute sur sa nature. C'est une allergie naso-sinusienne dûe au pollen des roses.

Rhazes en a décrit les signes, l'évolution et le traitement avec une clarté et une précision qui nous permettraient de lui attribuer l'honneur d'avoir décrit cette maladie pour la première fois dans l'histoire de la médecine.

(12) M. Meyerhof, "Thirty-Three Clinical Observations by Rhazes" *ISIS*, 23 (1935), 313-356,

مطبوعات
معهد التراث العلمي العربي
بجامعة حلب

آ ـ الكـتب :

١ ـ **أحمد يوسف الحسن** : تقي الدين والهندسة الميكانيكية العربية مع كتاب الطرق السنية في الآلات الروحانية من القرن السادس عشر ١٩٧٦ .
٨ دولارات

٢ ـ **جـلال شـوقي** : رياضيات بهاء الدين العاملي ٩٥٣ ـ ١٠٣١/هـ ١٥٤٧ ـ ١٦٢٢ م. ١٩٧٦ .
٨ دولارات

٣ ـ **سلمان قطـاية** : مخطوطات الطب والصيدلة في المكتبات العامة بحلب ١٩٧٦ .
١٠ دولارات

٤ ـ **ادوارد كندي وعماد غانم** : ابن الشاطر فلـكي عربي من القرن الثامن الهجري الرابع الميلادي ١٩٧٦ .
٦ دولارات

٥ ـ **ادوارد س. كندي** : أفراد المقال في أمر الظلال للبيروني .
جزء (١) : الترجمة الانـليزية .
جزء (٢) : التعليق والشرح (بالانـكليزية) .
٢٥ دولارا

ب ـ الدوريات :

١ ـ رسالة معهد التراث العلمي العربي ١ ـ ٣(١٩٧٦) ، ٤ (١٩٧٧) .

٢ ـ عاديات حلب حولية تبحث في تاريخ الفنوالعلوم ع ١ (٩١٧٥) ، ع ٢ (١٩٧٦) .
٦ دولارات للعدد الواحد

٣ ـ مجلة تاريخ العلوم العربية دورية عالمية متخصصة تصدر مرتين كل عام .
٦ دولارات

Publications of the Institute for the History of Arabic Science

BOOKS

Al-Hassan, Ahmad Y., *Taqī al-Dīn and Arabic Mechanical Engineering with the Sublime Methods of Spiritual Machines. An Arabic Manuscript of the* 16th *Century.* In Arabic. 165 pp. 1976. $ 8.00

Kataye, Salman, *Les Manuscrits Medicaux et Pharmaceutiques dans les Bibliothèques Publiques d'Alep.* In Arabic. 440 pp. 1976. $ 10.00

Shawqi, Jalal S. A., *Mathematical Works of Bahā' al-Dīn al-ᶜAmilī.* (953-1031 / 1547-1622). In Arabic. 207 pp. 1976. $ 8.00

Kennedy, E. S., Ghanem I., (Eds.), *The Life and Work of Ibn al-Shāṭir, an Arab Astronomer of the 14th Century.* In Arabic and English. 172 pp. 1976. $ 6.00

Kennedy, E. S., *The Exhaustive Treatise on Shadows by Abū al-Rayḥān Muḥammad b. Aḥmad al-Bīrūnī.* In English. Vol. I *translation.* Vol. II *commentary.* 281 pp., 221 pp. 1976. $ 25.00

PERIODICALS

ᶜĀdīyāt Ḥalab. An Annual Journal on Archaeology, History of Art and Science. In Arabic and English. Vol. I (1975) 368 pp., Vol. II (1976) 354 pp. Each Vol. $ 6.00

Journal for the History of Arabic Science. An International Journal. Vol. I 1977, Spring and Fall. 1 Yr. $ 6.00

I.H.A.S. Newsletter 1-3 (1976) 4 (1977).

To Contributors of Articles for Publication in the Journal for the History of Arabic Science

1. Submit the manuscript in duplicate to the Institute for the History of Arabic Science. The text should be typewritten, double-spaced, allowing ample margins for possible corrections and instructions to the printer.

2. Bibliographical footnotes should be typed separately according to numbers inserted in the text. They should be double-spaced as well, and contain an unabbreviated complete citation. For books this includes author, full title (underlined), publisher, place, date, and page numbers. For journals give author, title of the article enclosed in quotation marks, journal title (underlined), volume number, year, pages. After the first quotation, if the reference is repeated, then the abbreviation *op. cit.* may be used, together with the author's name and an abbreviated form of the title.

Examples :

O. Neugebauer, *A History of Ancient Mathematical Astronomy* (New York, Springer, 1976), p. 123.

Sevim Tekeli, "Taqī al-Dīn's Method of Finding the Solar Parameters", *Necati Lugal Armagani*, 24 (1968), 707–710.

3. In the transliteration of words written in the Arabic alphabet the following system is recommended:

ʾ	a	b	t	th	j	ḥ	kh	d	dh	r	z	s	sh
ء	ا	ب	ت	ث	ج	ح	خ	د	ذ	ر	ز	س	ش

ṣ	ḍ	ṭ	ẓ	ʿ	gh	f	q	k	l	m	n	h	w	y
ص	ض	ط	ظ	ع	غ	ف	ق	ك	ل	م	ن	ه	و	ي

For short vowels, *a* for *fatḥa*, *i* for *kasra*, and *u* for the *ḍamma*.

For long vowels the following diacritical marks are drawn over the letters *ā*, *ī*, *ū*.

The diphthong *aw* is used for أو and *ay* for أي.

Abdelhamid I. Sabra is Professor of the History of Arabic Science at Harvard University. He has published on the history of Arabic geometry and optics.

George Saliba has worked on the Syriac sources in chronology and planetary models. He is currently in the Department of Near Eastern Languages, Kevorkian Center, New York University.

Manfred Ullmann is a Professor of Arabic Studies at the University of Tübingen. He has published several volumes on medicine, natural sciences and the occult sciences in Islam. His interests also include alchemy.

NOTES ON CONTRIBUTORS

Sami K. Hamarneh is an historian of pharmacy and medical museology at the Smithsonian. He has several volumes on manuscript collections in medicine and pharmacy.

Ahmad Y. Hassan as President of Aleppo University and an historian of Arabic technology was instrumental in the foundation of the Institute for the History of Arabic Science. He is working on Taqī al-D n and a complete survey of water lifting machines.

Friedrun Hau is an associate professor in the Medizin-historisches Institut der Universität Bonn and working on the history of Arabic medicine.

Donald Hill is a practising engineer working on Islamic technology. He is completing an edition of Bānu Mūsā mss. at the present time.

Boris A. Rosenfeld is a scientist in the Institute for the History of Science and Technology of the Academy of Science of the U.S.S.R. He has several volumes on the history of non-Euclidean geometries as well as a long list of publications in the history of Arabic-Islamic mathematics.

Salman Kataye is a Professor of Otorhynolaryngology at the Faculty of Medicine, University of Aleppo. He has published several works on the history of medicine.

E. S. Kennedy is on leave from the American University of Beirut acting as Consultant to the Smithsonian Project on Medieval Islamic Astronomical Manuscripts in Cairo.His work has included commentaries on al-Bīrūnī al-Kāshī, Māshʾallāh, and al-Hāshimī.

David Pingree is Professor in the History of Mathematics Department at Brown University. He has recently published the first three volumes in the monumental Census of the Exact Sciences in Sanskrit. Other papers deal with Arabic astrology and astronomy.

Penelope Johnstone is Lecturer in Arabic Language and Literature at the Department of Near Eastern Studies ; University of Manchester, U. K. She has published in the history of Arabic medicine and on the use of medicinal plants in the Arabic–Islamic tradition.

1951). Für das Fehlende aber wird der Benutzer durch die vielen Nachweise von Arbeiten entschädigt, die an entlegener Stelle publiziert sind.

Nimmt man Ebied's Buch zusammen mit modernen Nachschlagewerken wie zum Beispiel dem dritten Bande der "*Geschichte des arabischen Schrifttums*" von Fuat Sezgin in die Hand, so kann man sich heute über die Geschichte der arabischen Medizin bibliographisch gut unterrichten. Die in den inzwischen vergangenen sechs Jahren erschienenen Arbeiten machen aber bald ein Supplement zu der "Bibliography" notwendig.

MANFRED ULLMANN*

Abū ᶜAbd Allāh Muḥammad al-Idrīsī. *Opus Geographicum.* Edited by Veccia Vaglieri, U. Rizzitano, et al. Sixth fascicule, Clima IV, sections 5-10. pp. 643-722 Arabic text. Leiden: E. J. Brill for the Istituto Universitario Orientale di Napoli, and the Istituto Italiano per il Medio ed Estremo Oriente, Napoli-Roma 1976. $ 15.20.

This is a part of an edition of the Arabic *Nuzhat al-Mushtāq fī Ikhtirāq al-Āfāq* by AbūᶜAbd Allāh Muḥammad, known as al-Sharīf al-Idrīsī (1100-1166).

The author is considered one of the most illustrious Muslim geographers of his time. This edition includes the discussions of parts five through ten, covering countries such as Syria, Iraq, Crete, and other islands of the Mediterranean (Al-Baḥr Al-Shāmī), and central Asia; areas which he considered parts of the fourth *Iqlīm.* It illustrates the author's appreciation of what today is regarded as basic elements of geography. It gives a good example of regional geography dealing with borders of countries, populations, towns, villages, lakes, and castles as well as ecology and environment.

This reviewer finds the edition accurate and reliable. He hopes that the editors will carry on a praiseworthy undertaking to its completion, so that scholars and historians of geography will have the entire work of al-Idrīsī in print.

R.D. MURSHED**

* Professor of Arabic Studies, University of Tübingen Germany
** National Geographic Society, Washington, D.C., U.S.A.

Rifaat Y. Ebied: *Bibliography of Mediaeval Arabic and Jewish Medicin and Allied Sciences*, With a Foreword by Professor A. M. Honeyman (Publica tions of the Wellcome Institute of the History of Medicine, Occasional Series II) London 1971, 150 pages.

Auf dem Gebiet der arabischen Medizingeschichte, das von der Forschun bekanntlich lange vernachlässigt worden war, ist in den letzten Jahren un Jahrzehnten eine Fülle von Arbeiten und Aufsätzen erschienen, die zum Tei an schwer zugänglichen Stellen veröffentlicht worden sind. Daher wurde Bibliographien als Hilfsmittel für die Forschung notwendig. Ein solches Hilfs mittel hat Rifaat Ebied, der an der Universität Leeds wirkt, mit dem hie angezeigten Buch vorgelegt. Er berücksichtigt auch Wissenschaften, die mi der Medizin in einem nur losen Zusammenhang stehen (zum Beispiel Alchemie Tierkunde, Landwirtschaft und Physik) und verzeichnet auch eine große Zah von Arbeiten, die der Medizin der Juden gelten. Das ist angesichts der viele Beziehungen, die im Mittelalter zwischen dem Islam und dem Judentum be standen haben, gerechtfertigt. Der große Komplex der lateinischen Überlieferun der arabischen und hebraischen Medizin ist aber unberücksichtigt gebliebe

Die Bibliographie umfaßt zwei Teile. Im ersten Teil (nr. 1-994) sind "allge meine Werke" genannt, im zweiten Teil (nr. 995-1972) sind die Schriften de arabischen und jüdischen Ärzte sowie Spezialarbeiten über diese Ärzte zusam mengestellt. Dieser zweite Teil ist nach dem Vorbilde von George Sarton *Introduction to the History of Science* chronologisch nach Jahrhunderthälfte gegliedert. Personen-und Sachregister beschließen das Buch.

Im einzelnen läßt die Bibliographie manchen Wunsch offen. Die Name sind nicht immer korrekt wiedergegeben. Statt "Silberger" (nr. 1096) muß e "Silberberg" heißen, statt "Canannsali" (nr. 1272) muß es "Canamusali heißen. Mehrfach sind Spezialarbeiten unter die "allgemeinen Werke" gerate wo sie nicht gesucht werden können. Arthur J. Arberry's Aufsatz "*An Unknow Work on Zoology*" (nr. 28) ist eine Studie über das *Kitāb Ṭabā'iʿ al-Ḥayawān* des Sharaf al-Zamān Ṭāhir al-Marwāzī, Chabot's "Version syriaque" (nr. 109 ist die Edition eines Fragmentes des *Kitāb al-Masa'il fi al-Ṭibb* von Ḥunayn ib Isḥāq, und Ṣidqiʿs Aufsatz "*Un banquet de Médecins*" (nr. 838) gehört zu Ib Butlan. Bisweilen sind auch verschiedene Autoren verwechselt: Fakr al-Di al-Razi zum Beispiel ist mit Muhammad ibn Zakariya al-Razi vermengt.

Es wäre ungerecht, den Wert einer Bibliographie nach ihrer Vollständigke zu beurteilen. Man bedauert aber doch, daß hier so wichtige Arbeiten fehle wie Richard Walzer's Edition der galenischen Schrift über die Siebenmonat kinder (*Rivista degli Studi Orientali* 15, 1935, pp. 323-357), sein Buch "*Gal on Jews and Christians*" (Oxford 1949) oder sein Buch "*Plato Arabus*" (Lond

Book Reviews

Adolf P. Youschkevitch. *Les Mathématiques Arabes (VIII^{e} - XV^{e} siècles)*. Traduction française de M. Cazenave et K. Jaouiche. Paris : Librairie philosophique J. Vrin, 1976. x + 214 pp.

In 1961 A.P. Youschkevitch, the dean of Soviet historians of mathematics, published his *Istoriya matematiki v srednie veka* (History of Mathematics in Medieval Times). An excellent book, it is unique in being the only work ever written on this subject. Hence it is not surprising that German, Polish, Roumanian and Japanese translations have appeared, and a Czech version is on the way. An English translation is long overdue, and one into Arabic is now being planned.

The volume here reviewed is a French translation of the third part of Youschkevitch's book, the sections describing the mathematics developed or practised in the countries of medieval Islam. During the sixteen years which have elapsed since the Russian version appeared, considerable additional knowledge has accumulated, and the author has collaborated with the translators in bringing the work up to date with additional footnotes. The original bibliography of 159 titles has been increased by twenty new ones. But the field is advancing so fast that in the interval between sending the French translation to the press and the writing of this review still more research results have become available.

The author sets the stage by commencing with a fourteen page chronological review, sketching the expansion of the Arab empire and its subsequent breakup into independent principalities as a frame for the accompanying scientific activity. The remainder of the exposition then proceeds by topics, except that where prominent mathematicians are introduced, biographical paragraphs are inserted. The subjects discussed include: the spread of the decimal place-value system; algebra, particularly that of al-Khwārizmī, Abū Kāmil, al-Karajī, and al-Qalaṣādī; number theory; the invention of decimal fractions; irrationals and the theory of proportions; Khayyām's solution of the cubic; work on Euclid's postulate of parallels; infinitesimal methods; the development of trigonometry; and computational mathematics including al-Kashi's π-computation. Throughout, the emphasis is on the mathematics itself rather than a recital of names, places, and dates. The concluding section describes the influence of this work upon the West.

E. S. Kennedy*

* Smithsonian Institution Project in Medieval Islamic Astronomy, American Research Center in Egypt, Cairo, A.R. Egypt.

2. *Mathematical Treatises*, 1972; translated by A. Kubesov, I. O. Muham mad, S. A. Krasnova, M. F. Bockstein, and R. S. Sharafuddinova; commentar by B. A. Rosenfeld and the translators.

3. *Social-ethical Treatises*, 1973; translation and commentary by B. Ya Osherovich.

4. *Treatises on Logic*, 1975; translation and commentary by B. Ya Osherovich, E. D. Harenko, and N. N. Karaiev.

5. *Commentary to Ptolemy's Almagest*, translated by A. Kubesov an J. al-Dabbagh; commentary by A. Kubesov and B. A. Rosenfeld.

Volumes 1 and 3 above have also appeared in Kazakh translation.

BORIS ROSENFELD

Notes and Correspondence

Recent Publications in the Institute for the History of the Natural Sciences and Technology, Moscow

The Institute for the History of the Natural Sciences and Technology, Moscow, U.S.S.R., announces the following additions to the Russian language series "Selected Works of Bīrūnī," by the publishing house "Fan" of Tashkent.

Volume 4, 1973 : *Pharmacopoeia*, translation and commentary by U.I. Karimov.

Volume 5, Part 1, 1973: Part 2, 1976; *Masoudic Canon*, translation and commentary by P.G. Bulgakov, B.A. Rosenfeld, A. Ahmedov, M.M. Rozhanskaya C. A. Kransnova, and Yu. P. Smirnov. (This volume appeared simultaneously in Uzbek, translated by A. Rasulev and A. Ahmedov.)

Volume 6, 1975; *Explanation of the Elements of the Science of the Stars (the Tafhīm)*, translated by B. A. Rosenfeld, A. Ahmedov, M. M. Rozhanskaya, A. A. Abdurahmanov, and N. D. Serveieva.

The Institute also announces as in the "Nauka" Press for publication, a book (in Russian) by G. P. Matvievskaya and B. A. Rosenfeld, "Mathematicians and Astronomers of the Arab Countries and the Near East and their Works, 8th-17th Centuries". The book includes an introduction by the authors and A.P. Youschkevitch; thence articles on about a thousand mathematicians,astronomers, and natural scientists, of known life dates, from the Arab countries, Iran, Central Asia, Turkey, Afghanistan, and North India, who wrote in Arabic, Persian and Turkish. Further there are articles on some two hundred and fifty savants of unknown date, and an additional hundred about anonymous scientific manuscripts of the period. For the most important scientists, the articles report sections and chapters of their major works, together with their scientific accomplishments. For all entries, after giving biographical sketches, the articles report known works, the locations of extant manuscript copies, published editions of works, and relevant modern studies. An extensive bibliography is appended.

The "Nauka" publishing house of the Kazakh SSR in Alma Ata has brought out (in Russian) the following works of al-Fārābī :

1. *Philosophical Treatises*, 1970; translated by B. Ya. Osherovich, A. C. Ivanov, I. O. Muhammad, and A. B. Sagadeiev; commentary by A. H. Kasimov and the translators.

يابسه وسماق منقى وارز مغسول دفعات من كل واحد
عشرة دراهم يطبخ الجميع في ثلاثة ارطال ماء حتى يبقى
منه ثلثه ثم يصفى ويشرب منه كل يوم ثلاث اواق
ويدهن ايضا بدنه يدهن بدهن سفرجل ويذر على بدنه
طين ارمني واس وورق الطرفا مدقوقة كالغبار وايضا
يدهن بدهن الاس ودهن الخلاف ومما يمنع العرق
ان يمسح البدن بدهن الورد ودهن الاس ويصب
عليه ماء الورد ويروح بالمراوح وينام العليل في
موضع قد صير فيه ورق الخلاف وورق الكرم والاس
وورق الكزبرة والتفاح تم الاقراباذين

بعون الله وكرمه مما الفه
الاجل امين الدولة موفق
الملك رئيس الحكما ابو الحسن
هبة الله صاعد بن التلميذ

ووافق الفراغ منه في الخامس والعشرين من شهر ربيع الاول
سنة اثنين وتسعين ...

ومنافعه وجميع صفاته انما تصدر عن خاصيه مع صورته الحاصلة
عن امتزاج بسايطه بتقوية ... والروح فتقاوم المفسدات

Fig. 5 : *The last page of Ibn al-Tilmīdh's (d. 1165) medical formulary,* al-Aqrabādhīn *which was widely used by pharmacists for the compounding and dispensing of medications (Sommer, A-3).*

الشكل الخامس : دستور الادوية تحت عنوان **الأقرباذين** لابن التليمذ ت سنة ٥٦٠ هـ حلّ استعماله في دكاكين الصيادلة مكان كتاب سابور بن سهل في الموضوع نفسه ·

عروض البدن من شرب الادويه القتالة المؤذية للبدن

الادوية القتاله تتبعها ان كانت حارة تقتل اما بافراط حرها علامات الحرارة المحرقة او في الحرارة المحرقة وان كانت بارده فدلايل البرودة المجمدة وبعضها البرد المجمد وبعضها ضد مع مضادة جوهره كالبيش الجوهر الغشي وضعف النفس وبرد الاطراف

علاج

البيش اسرع الادوية قتلا واوحاها ولا يكاد يتخلص شاربه
ويقتل منه حبتين وربما قتل برايحته وقد يعرض لمن شربه سقوط
النفس ولذع اللسان ثم دوار لاعدم ثم يتضرع وعلاجه ان ينفع منه شي
المبادرة بالقي بما قد طبخ فيه بزر شلجم مع سمن بقر ثم ناوله من ترياق
الافاعي نصف مثقال بشراب وقيل ان دوا المسك افضل من
من الترياق للبيش وقيل ان قشور البلوط اذا طبخت مع الشراب
نافعة له وكذلك قشور اصول الكبر ومن نجا من سلامته من
هذا الدوا فلا يومن عليه من السل فاما من سقي قرون السنبل
فليأخذ بالقي ثم ناوله خمسة قراريط من كافور قيصوري بما
ورد ورد المزاج ما خذ ما الشعير مع اقراص الكافور ورد الكبد
بالصندلين فاما من شرب الذراريح وخاصيتها تقريح المثانة
بالقي بالما الفاتر ودهن اكل ثم ناول المريض ما الشعير

Fig. 4 : *A page of Ibn al^cAyn Zarbī's (d. 1153) medical compendium* al-Kāfī *(Sommer, A-25). This page starts with a discussion of potent drugs and symptoms of poisoning.*

الشكل الرابع : صفحة من كتاب ابن العين‌زربي ، **الكافي** في شرب الادوية القتالة المؤذية للبدن من المقالة الثانية .

Fig. 3 : *A page from a compendium erroneously ascribed to Galen. (Sommer A-39). Based on Greek writings on anatomy and pathology, the book was compiled in the time of Thābit b. Qurrah or after. This page has the beginning of the thirty-third section, on toxicology.*

الشكل الثالث : الميمر الثالث والثلاثون من كتاب طبي كان يظن انه من كتب جالينوس ولكنه تأليف عربي يذكر الطبيب ثابت بن قره .

النفس لما فرغ حنين من البحث عن المعاني التي
تنظم قوانين الادويه المفرده اخذ من هاهنا يتكلم في القوانين
التي يعمل عليها في تركيب الادويه المركبه وهذا هو القسم
الثاني من هذا الفصل السادس الذي رمنا شرحه والله تعالى
هو المعين فنقول ان هذا التعليم يتضمن معنيين احدهما
البحث عن الدستور الذي يستخرج به اوزان الشربه من
الادويه المفرده ليتوصل بذلك الى مقدار الشربه من المركبه
منها والاخر البحث عن السبب الذي له صار يلقي من الدوا
الواحد في الادويه المركبه اوزان مختلفه اما الدستور الذي
يعمل عليه في استخراج اوزان الاشربه من الادويه المفرده
فان الادويه تتناول اما ليستفرغ او ليحبس او لتغير المزاج
اما الدستور الذي يعمل عليه في وزن الادويه التي تستفرغ
وهي المسهله فهو اعتبار التجربه لا غير فان التجربه توصلنا
الى الشربه من السقمونيا هي من ربع درهم الى نصف درهم
والشربه من شحم الحنظل من ثلث درهم الى الثلثين والشربه
من التربذ من درهم الى درهمين وان زعم احد ان للطعم في
هذا الباب حظا فهو نزر جدا لا يستحق ان يعبا به واما
الادويه الحابسه فالتجربه تميز بين ما هو اكثر او اقل حبسا
وللطعم في هذا الباب حظا اكثر لان الذوق ينبه على الطعم
القابض جدا واما الادويه المبدله للمزاج فالاقل والاكثر في
اوزان الشربه منها يستخرج من مزاج البدن ومن كميه

Fig. 2 : *A page of Ibn Abī Ṣādiq's important commentary on Ḥunayn's al-Masā'il. It relates to the author's instructions concerning simple and compounded drugs and the laws governing their collection and preparation for treatment.*

الشكل الثاني : صفحة من شرح ابن أبي صادق على مسائل حنين في الطب .

Fig. 1 : *The first page of the "Epistle on the Signs of Death", erroneously ascribed to Hippocrates (Sommer, A-84,2). This and all other illustrations in this essay are reproduced by courtesy of the National Library of Medicine.*

الشكل الاول : رسالة أو فصول في البثورفي الانذار بالموت 'ترجمت من اليونانيـــة الى العربية وهي ليست من كتابات ابقراط الاصيلةوهذه النسخة وغيرها من الاشكال في هذه المقالة محفوظة في المــكتبة الطبية الوطنية في العاصمةالاميريكية ٠

Lastly, he presents an intriguing method for studying the various medical topics:

1. The two part classification, as in dividing medicine into theory and practice; diseases into physical and mental; death into natural and violent, or unnatural; and the elements into light and heavy.

2. The three part classification, such as studying treatment under the divisions of diet, drug, and surgery, or considering the main bodily organs as the heart, brain, and liver.

3. The four part classification, as in studying the elements : earth, water, air and fire, or dividing the human life span into : growth, youth, manhood, and old age.

4. The five part classification, as of the senses: sight, hearing, smell, touch, and taste.

5. The six part classification, as in considering the six principles required for maintaining good health: the air we breathe, food, work and rest, sleep and wakefulness, evacuation and purgation, and emotional responses الاسباب الستة لحفظ الصحة .

6. The seven part classification, as the division of natural matters into the elements, humors, temperaments, powers or faculties, spirits, actions or functions, and organs; and so on. Two copies of this work are at the library designated by Sommer as A-16, p. 302, and A-84, fols. 1-39, p. 325,[72] copied by Kamāl al-Dīn Masᶜūd b. M. b. Alī al-Kirmānī and dated 971/1563.

72. Brockelmann, *Supplement*, 2:299;
وحاجي خليفة ، كشف ، ١ : ٦٧٢ ؛ والبغدادي ، ذيل كشف الظنون ، ١ : ٤٠٨ .

century physician mentioned above, Nafīs b. ᶜImād al-Kirmāni, is entitled simply شرح الموجز Sommer A-63, p. 318.[70]

Termination of a Great Cultural Period

The admirable cultural activities of this long and fruitful Islamic period gradually came to a close. There were flickerings of light that lingered on during the fourteenth century and beyond. One such shining example was the physician Masᶜūd b. Maḥmūd (Muḥ.) al-Sījāzī (or al-Sinjārī in northern Iraq) who flourished in the second quarter of the fourteenth century. A contemporary of Kazarūnī, his book on the elucidation of the secrets of the healing arts, حقائق أسرار (الاسرار في) الطب او الاطباء , is his only known work. It was compiled for the library of his noble patron, Prince Abū al-Mafākhir Qāṣim b. ᶜIrāq b. Jaᶜfar whom he praises highly for his love of knowledge and generous support of learning. As the prince expressed interest in knowing more concerning medical and technical idioms and terminology in the literature, to explain such matters the author responded in writing. This book comprises three discourses:[71]

1. On interpreting and defining medico-pharmaceutical words and expressions used by professionals in the health fields, and on names of diseases.

2. On collected and preserved simples of the materia medica, and how they enter into the various remedies by pounding, pulverizing, cooking, and similar processes.

3. On defining the meanings and listing the synonyms of composite drugs and their actions, methods of preparation, as well as the defining of each pharmaceutical form: electuaries, confections, and ointments, as well as the therapeutic qualities and quantities (dosages) of compound medications

He defines health, for example, as the state in which the temperaments and constitution of the body demonstrate a healthy attitude بحيث تصدر عنها الافعال السليمة with proper and sound performance. Disease is the opposite. He explains that the natural humors are produced from the diet or the nutrition one receives, and that digestion occurs first in the stomach, then in the liver, and thirdly in the blood vessels and the related digestive organs. Absolute nutrition is the diet that, taken into the body, is completely assimilated so that through the process of digestion these received foods and drinks replace what had been consumed through the body's various activities. Blood is formed يتولد من الاغذية دم for the same purpose. These are ideas of interest in the history of physiology.

70. Brockelmann, *GAL.*, 2:276; and *Supplement*, 2:299; and Cyril Elgood, *A Medical History of Persia*, Cambridge, University Press, 1951, pp. 156, 304 and 336.

71. Iskandar, *Catalogue*, p. 104; and Hamarneh, *British Library*, p. 204;

Ibn al-Nafīs (ca. 1209-1288 *)*

We possess, from I. A. Uṣaybīʾah's personal accounts of his time, an adequate knowledge of the remarkably developed medical activities in Syria and Egypt. His contemporary was the physician-theologian ᶜAlaʾ al-Dīn ᶜAlī b. A. al-Ḥazm al-Qarshī, known as Ibn al-Nafīs. He practiced in Cairo, where he became a leading physician and medical educator, as his contemporary Ibn al-Quff (1233-86) was in Damascus. Important among Ibn al-Nafīs' books was his commentary on Ibn Sīnā's *Qānūn* شرح تشريح القانون. In it, for the first time, Ibn al-Nafīs explained definitely and clearly the pulmonary circulation of the blood in defiance of Galen and other Greek authors and their Arab followers.[76]

Another widely circulated work of Ibn al-Nafīs is his concise compendium on medicine (الموجز في الطب (موجز القانون . Apparently it was compiled as a condensation of Ibn Sīnā's voluminous *Qānūn*. But in reality it is not a summary of that, but an independent work altogether. The library houses two copies of it, Sommer A-43 and 44, pp. 311-12. It comprises four sections:

1. On the theory of medicine, anatomy and physiology, hygienic regulations including diets, exercises, rest, and work.

2. On materia medica, in alphabetical order, and the technology and uses of composite remedies.

3. On the diseases of the bodily organs from head to foot, their causes, symptoms, and treatment and related diseases such as diabetes, arthritis, and the pains of hemorrhoids.

4. On unspecific diseases, such as fevers, plagues, bodily injuries, skin diseases, and poisoning.[68]

The *Mūjiz* was well accepted by practitioners, as is evident from the number of extant copies, as well as the fact that many commentaries and summaries appeared. The library's collection contains such a medical commentary by Sadīd al-Dīn al-Kāzarūnī (d. 1344) entitled الشرح المغني (في شرح الموجز) أو شرح موجز القانون mentioned by Sommer, الشرح المغني على الموجز القانوني في الطب A-61, p. 317, a copy containing the fourth section only.[69]

Soon after the death of Kāzarūnī, the physician Jamāl al-Dīn Muḥ. al-Aqsara'i (d. 779/1378) completed his commentary under the title حل الموجز Sommer A-67, p. 319; and dated 801/1401. Another, followed by the 15th

67. Ullmann, *Medizin*, p. 173; Hamarneh, *Br. Library*, pp. 194-99;
والبغدادي في هدية العارفين ، ٢ : ٧١ وفي ايضاح المكنون في ذيل كشف الظنون ، ٢ : ٤٦ .

68. Ibn al-Nafīs' *al-Mūjiz* was edited at Calcutta, Education Press, 1244/1828 by Muḥ. Sul. al-Harawi et al. See also Iskandar, *Catalogue*, pp. 52-56, 100-103, 143-149.

69. Kazarūnī's *Al-Sharḥ al-Mughnī* was edited in Calcutta, 1249/1832 by Mawlawī ᶜAbdul Majīd et al. The library possesses a copy of this rare edition. It is a commentary on I. Nafīs' *Mūjiz*.

Physicians, therefore, are bound to recommend to each patient the foods that suit him best, avoiding those which are harmful. For example, he speaks of gout as a dietary disease, and like al-Rāzī before, he confirms that it occurs among the wealthy, who live in luxury, indulge in eating and drinking, and take little if any exercise. He advises against tight shoes, too much sitting or horse riding, and refers to nature's power to heal.

Of general interest is Samarqandī's book on foods and drinks for the healthy, listed by Sommer as A-82, fols. 1-88, p. 324. It is compiled from earlier compendiums. Better known is his formulary *al-Aqrābādhīn* الاقرباذين على ترتيب العلل arranged according to diseases and the required medical recipes for each ailment (Sommer, A-82, 89b-176b).

Possibly Samarqandī's best known work is his book on the causes and symptoms of diseases في الاسباب والعلامات, Sommer A-83, fols.1-162. It is a compilation, for the author's personal use in his practice, from earlier works such as al-Majūsī's *Kāmil*, al-Ṭabarī's *Muᶜālajāt*, and Ibn Sīnā's *al-Qānūn*.[64] In so doing, he followed Rāzī's recommendation that each practicing physician should compile such a manual for his own utilization. Even the book's title is largely borrowed, from Sharaf al-Dīn Muḥ. b. Yūs. al-Ilāqī's abstracted commentary on *al-Qānūn*, and others. But Samarqandī's book had acquired wider popularity so that it was commented on by the physician Nafīs b. ᶜIwaḍ al-Kirmānī (d. 1446) كتاب شرح الاسباب والعلامات, a copy of which is at the library (Sommer A-60, p. 317).[65] And with the decadence of Islamic medicine in the later period the number of commentaries on commentaries increased, showing no originality. Mediocre works, such as Samarqandī's *Asbāb* and the commentary on it by al-Kirmānī in the 15th century were composed. Another commentary on the latter was written, of which a copy is held by the library under No. A-66-1.[66]

64. These references were acknowledged in the author's introductory remarks. He made clear that at first he compiled this manual for his own use as a practitioner.

65. Kirmānī's commentary was published at Lucknow, Yusufi, 1905. See Iskandar, *Catalogue*, pp.174-78.

66. A similar tendency to mediocrity can be found also in a recent Library acquisition (A-19-1). It is a 4 folio epistle, 19 lines, 12½ × 20¼ cm., in elegant Naskh script with rubrications on dentifrices and mouth hygiene composed of five chapters رسالة في حكم السواك وأصله وكيفية استعماله وفوائده. It presents a description of the material, methods of usage, social, physical and religious benefits derived from the *Siwak* (tooth pick) taken from the Caparis sodata, olive or pomegranate trees. The tip is softened by chewing or beating. It is used for cleaning and polishing teeth, and refreshing, strengthening, and purifying teeth, mouth and gums. "It helps guard against dental caries and pleases the Lord." It was written by a certain Muḥ. al-Aq Kirmānī. The topic generally is referred to in Arabic poetry since pre-Islamic times. Yūḥanna b. Māsawayh in the ninth century wrote on the subject ;
بعنوان كتاب في السواك والسنونات ، وكتب فيه شهاب الدين ابو القاسم عبدالرحمن بن اسماعيل المقدسي ابو شامة (١٢٠٣ - ٦٨) ومنه نسخة في مكتبة الفاتيكان وقد ذكره القفطي ، ٣٨٠ - ٨١ ، وابن ابي اصيبعة ، ١ : ١٨٢-٣ وبروكلمان في الملحق ١ : ٥٥٠ - ٥١ .

On the same topic, the library possesses a manuscript entitled زاد المسير في علاج البواسير by the physician Badr al-Dīn Muḥ. b. Muḥ. al-Qawṣūnī (flourished about 1525), listed by Sommer as A-92, 3, p. 329. Qawsūnī dedicated this epistle to the religious governor of the Manūfīyah province in Egypt, Aḥmad b. Sulaymān. In its four chapters and the epilogue, the author discusses the identification of hemorrhoids, their three main kinds classified by shape, their causes, symptoms, rules for diet, and treatment with drug or surgery.

Qawṣūnī, moreover, was the author of the important medical treatises :

1. Discourse on the healing art تحفة المحب في صناعة الطب, of which there are two copies in Cairo, Nos. 39 and 568 *Ṭibb.*

2. Book on therapy, prescribing useful and commonly tried medications الدرة المنتخبة فيما صح من الادوية المجربة .

3. Book on toxicology and antidotes, في السموم والترياقات which may be the same as or including the one on animal antidotes and the bezoar مقالة في استعمال حجر البادزهر الحيواني of which a copy is in Cairo No. 143 *Ṭibb.*[61]

Najīb al-Dīn al-Samarqandī (d. 619/1222)

A leading Muslim figure who practiced medicine in what is known today as Afghanistan was Najīb al-Dīn Abū Ḥamīd Muḥ. al-Samarqandī. He was killed at Herat by the invading Tartars, who mercilessly sacked the city. Several of his medical works are still extant.[62]

The library has his treatise on materia medica and popular remedies الادوية المفردة المستعملة بخواصها وافعالها المنسوبة اليها المشهورة بها . It is compiled and arranged in alphabetical order, and contains chapters on laxatives, dairy products, and meats and cereals. It was copied (A-1,1, fols. 1-29) by the physician Muḥ. b. ᶜAbd Allāh al-Shamsī al-Tasatturī and dated in late Ramaḍān 740/1339. It is followed by three pages on cheese water مـاء الجبن (milk mixed with oxymel, rennet, and safflowers) and its uses.[63]

The Library has in addition two other books on regimen في أغذية المرضى, A-80-1 and A-82,3, fols. 177b-200 (the latter only is listed in Sommer, P. 324). In this regard, Samarqandī confirms that since individuals vary in their makeup, habits, and physical conditions, their diets must necessarily vary.

61. Brockelmann, *GAL.*, 2:447 and *Supplement*, 2:666, H. Khalīfah, *Kashf*, 1:744

ومنه نسخة في الاسكندرية رقم ٣٨١٩ ج ذكرها شبوح في فهرس الطب ، ص ٩٨ .

62. I.A. Uṣaybiᶜah, *ᶜUyūn*, 2:31; Leclerc,*Histoire*, 2:127-28; Brockelmann, *GAL.*,1:646-7; *Supplement*, 1:895-96;

ذكره شبوح في فهرس الطب ، ص ٩٤ .

63. *Ibid.*, p. 12-13, 195-96; Iskandar, *Catalogue*, pp. 83-84;

وقد ذكره البغدادي في هدية العارفين ؛ ٢ : ١١٠ ؛ والزركلي ، الاعلام ، طبعة ثانية ، ج٧ : ١٥٩

6. On hemorrhoids في البواسير translated into Hebrew, Spanish and other modern languages.[59]

Of this last treatise, there is a copy at the library, Sommer A-90,1, fols. 1-6, copied by Maḥmūd b. Muḥ. al-Alfī al-Ḥanafī and dated 1241/1826. In seven chapters, the author warns against indulgence and indigestion due to the intake of bad-quality foods at improper intervals. "Once the food is insufficiently digested in the stomach it will face the same problem in the liver, intestines and other digestive organs... Therefore, one has to choose the best and most healthy foods and drinks and take of them moderately at the proper time, avoiding what is harmful,... for too much eating by the healthy or the sick causes harmful extension in the stomach walls (as they swell). Also this will lead to the habit of eating more than one should, and frequently, before digestion is completed."

Significantly, Ibn Maymūn was the first known physician to recommend the use of effervescent (vaporizing) medication for discomfort caused by indigestion. He warned against strong spices, mustard, and certain foods such as cucumber, onion, garlic, radish, vinegar, lemon, fat, and sweets. He recommended simple dishes, cooked vegetable and cereals, eggs and julep water to be taken one kind at a time. In painful hemorrhoids requiring surgery, due consideration should be given to age, sex, and the duration and progress of the ailment. He tried to avoid surgical operations when at all possible.

For those clients who do not heed the physician's advice, Ibn Maymun wisely and wittily states "when they get sick, they blame it on the doctor, and accuse the healing art for failing to offer the help expected from it."

His patron being a rich man, he recommended things that only the well-to-do can afford or secure. This reminds us of the Hippocratic proposition that only the rich are able to afford health. Such was Ibn Maymun's patron, who requested the composition of this treatise.

Of hemorrhoids, he speaks of the type that opens and bleeds, considering it the easier to treat. The type which does not open and allow blood out he considers the more difficult to treat or cure. He recalled several hemorrhoidal cases with which no sooner had he operated than new piles appeared in place of the old. Therefore he prescribed "special treatment, if faithfully followed, will relieve pain, prevent reoccurrences and save the patient the dangers inherent in surgical operation."[60]

59. See H. Kröner, "Die Haemorrhoiden in der Medizin des XII und XIII Jahrunderts," *Janus*, 16 (1911), pp. 441-56 and 645-718; a Hebrew translation was published in Jerusalem, 1965. Two other manuscripts on the same topic were also inspected in Princeton, N.J., and London.

60. The topic is beautifully analyzed in L. Edelstein's *Ancient Medicine*, O. and C.L. Temkin editors *op. cit.*, pp. 303-16. Maimonides patron was a highly placed government officia lwith considerable wealth so that Maimonides was able to observe the treatment in all its detail. We are told that originally the patron only ran to the doctor when hemorrhoidal pains were severe, then he rushed back to work. Subsequently, upon Maimonides' recommendation, he was to follow in detail all the medical instructions to prevent reoccurrences of the disease.

al-Fāḍil ᶜAbd al-Raḥīm b. ᶜAlī of Baysān, wazīr to the Ayyubid King Ṣalāḥ al-Dīn السلطان صلاح الدين (Saladin) to whom he dedicated several of his works. He later served Ṣalāḥ al-Dīn himself and his son, King al-Afḍal ʿAli. He was also the religious leader of his coreligionists in Cairo where he died. However, he was buried as he had requested at Tiberias in Palestine.[54]

فيه يقول الشاعر : أرى طب جالينوس للجسم وحده وطب أبي عمران للعقل والجسم

The "Physician's Prayer" code ascribed to him is not genuine, but he wrote several medical works, many extant. Important among them are the following:

1. *Al-Fuṣūl fi al-Ṭibb* completed between 1187-90, containing some 1500 aphorisms and medical concepts in 25 treatises, copied and original, of historical interest.[55]

2. *Tadbīr al-Siḥḥah* on hygiene, drug therapy, and dietetics, in four treatises. It was written in response to King al-Afḍal's request for an epistle on the best medical treatment of common ailments (completed about 1198).[56]

3. A glossary on materia medica, في شرح أسماء العقار edited with French translation and useful introduction and annotations by Meyerhof.[57]

4. A book on toxicology في السموم والتحرز من الادوية القتالة

5. On asthma مقالة في الربو[58].

54. Sarton, *Introduction*, 2:369-80; Leclerc, *Histoire*, 2:57-63; Brockelmann, *GAL*, 1:644-46; *Supplement*, 1:893-94; Hamarneh, *Bibliography on Medicine and Pharmacy in Medieval Islam*, Stuttgart, 1964, pp. 75-77; Ullmann, *Medizin*,1970, p. 168; and F. Wüstenfeld, *Geschichte der arabischen Aerzte und Naturforscher*, Göttingen, 1840, pp. 109-111;

والقفطي ، تاريخ الحكماء ، طبعة ليبزج ص ص ٣١٧ ـ ١٩ ، وابن ابي اصيبعة ، عيون الانباء ، ٢ : ١١٧ ـ ٨ ؛ وابن العبري ، مختصر ، ص ص ٢٣٩ ـ ٢٤٠

55. Moritz Steinschneider, "Die Vorrede des Maimonides zu seinem Commentar ueber die Aphorismen des Hippokrates," *Zeit. deutsch. morgenländ. Gesellsch.*, 48 (1894), pp. 218-234. In this work on the *Aphorisms*, Maimonides criticizes Galen and other Greek writers on the subject and quotes Ibn Masawayh, al-Rāzī, and al-Fārābī, and cites original observations.

شبوح ، في فهرس الطب ، ص ص ١٣٩ ـ ١٤٠ يذكر ٢٥ فصلا في هذا الكتاب ويشير الى مخطوطي رضا ورامبور (اسطنبول) .

56. Maimonides' *Regimen Sanitatis* was translated and commented upon by A. Wasif, في تدبير الصحة Cairo, 1908, reprinted 1932 مطبعة المحيط, see also the edition by A. Bar-sela et al., *Moses Maimonides' Two Treatises on the Regimen of Health*, Philadelphia, American Philosophical Society, *Transactions*, 1964, Vol. 54, Pt. 4; and H. L. Gordon, *The Preservation of Youth*, New York, Philosophical Library, 1958.

57. *Un glossaire de Matière Médicale Composé Par Maimonide*, edited with translation and useful introduction and annotations by Max Meyerhof, Cairo, Institut d'Égypte, 1940.

58. See S. Müntner, *The Medical Writings of Maimonides*, Vol. 1, *Treatise on Asthma*, Philadelphia, Lippincott, 1963; Vol. 2, *Treatise on Poisons and Their Antidotes*, same publisher, 1966; and *Maimonides Regimen Sanitatis oder Diatetik fuer die seele und den Koerper*, Basel, S. Karger, 1966. See also I. Wolfensohn,

موسى بن ميمون ، حياته ومصنفاته ، القاهرة ، لجنة التأليف والترجمة والنشر ، ١٩٣٦

p. 297) which replaced that of Sābūr.[51] Collected from earlier medical formularies and compendia, it played a part in the history of pharmacy and pharmaceutical preparations. It discussed properties, forms, and actions of tablets, powders, pills, electuaries, decoctions, ointments, bandages and poultices, gargles, and dentifrices and the techniques involved in preparing their recipes. It ends by prescribing remedies against obesity and medicines to reduce perspiration.[52]

Another genuine work by Ibn al-Tilmīdh, is possessed by the library. It was ascribed to Ibn Sīnā because of a conventional title, المقالة الامينية *al-Āmīnīyah*. It is Ibn al-Tilmīdh's treatise on bloodletting مقالة في الفصد (A-58-1), in an 18th-century copy (in small, crowded but legible Naskh, in seven folios). In its ten chapters, the author defines phlebotomy (الفصد), the advantages it has in certain ailments, and when it should be avoided.[53]

In this connection, it seems relevant to mention a similar work on bloodletting and cupping entitled تهذيب المقالة فيما ورد في الفصد والحجامة(Sommer, A-88, 3, fols. 57-62, p. 327, copied 1217-1802). Its author Muḥ. b. Muḥ. al-Tāfilātī (d. 1777), was the Muslim supreme justice (al-Muftī) of Jerusalem, a Hanafite theologian. It focuses on the interpretation of 51 traditional and religious sayings mixed with folk medicine. The period when it was written was, of course, a time of decline and lack of innovation in medicine throughout the region.

Abū ᶜImrān Mūsā b. Maymūn (Maimonides, 1135-1204*)*

One of the leading figures in philosophy and medicine in the second half of the twelfth century was *Abū ᶜImrān Mūsa b. Maymūn* (hence known in the West as Maimonides) al-Qurṭubī (because he was born at Cordoba, in Moorish Spain). At that time, the Muwaḥḥid sultan ᶜAbd al-Muʾmin b. ᶜAlī (1130-63) ordered the persecution of Christians and Jews in his domain unless they embraced Islam (an act contrary to the teachings and spirit of the religion). Therefore, Ibn Maymūn fled with his family at the first convenient opportunity. He finally settled in the Fusṭāṭ of Egypt (old Cairo). Here, for almost forty years, this Hispano-Jewish philosopher, theologian, astronomer, and physician reached the pinnacle of fame. His star began to shine brightly with the rise to power of the Ayyūbids. He found a generous patron in al-Qāḍi

51. Hamarneh, "Sābūr's abridged formulary, the first of its kind in Islam," *Sudhoffs Archive*, 45 (1961), 257-60 and *Br. Library*, pp. 138-40;
معجم الادباء لياقوت الحموي ، طبعة القاهرة ، ج ٧ . ٢٤٣ - ٤٧ وابن العبري ، تاريخ مختصر الدول ، المطبعة الكاثوليكية ، بيروت ، ١٩٥٨ ، ص ص ٢٠٩ - ١٠ ، ٢٣٩ ، وشبوح ، فهرس الطب ، ص ص ٢٣-٢٤ .

52. Compare with Iskandar, *Catalogue*, pp. 129-31, and Hamarneh, *Ẓāhiriyah*, pp. 452-54.

53. *Ibid.* Three teatises on bloodletting are ascribed to Galen; in one he unwittingly criticizes Erasistratus for cautioning against bloodletting; and in another he criticizes his followers. See Sezgin, *Geschichte*, 3:115, 131.

consequences. Economic expansion and political conflicts stimulated physicians and educators into this flourishing of intellectual productivity. Several famous figures appeared on the scene, but only a few will be mentioned here.

Ibn al-ᶜAyn Zarbī was one of those illuminating stars, and a 14th-century copy of his medical compendium *al-Kāfī fī Ṣinaᶜāt al-Ṭibb* الكافي في صناعة الطب is held by the library (Sommer, A-25, p. 305). Although this copy is not complete, the original *al-Kāfī* is composed of three sections:

1. On hygiene, origin and condition of plagues (especially in Egypt, where the book was written), their prevention and recommended treatment. It includes material on environmental as well as physical and psychic health, all in 21 chapters.

2. On diseases from head to foot, their causes, symptoms and treatment, with extremely interesting personal observations and innovations, all in 196 chapters.

3. On astrology as it relates to medicine.

An older copy examined by this writer is Granada No. 20, copied in 702/1302 by the Andalusian physician, (يوسف المالقي) Yūsuf b. Muḥ. b. Yūnus al-Qaysī of Malaga. Others examined are in Aleppo, Cairo, Oxford, and Paris.[49]

Hibat Allāh b. al-Tilmīdh (d. Ṣafar 560/Jan. 1165)

Ibn al-Tilmīdh was the leading medical authority in Baghdad during his time. He traveled to Persia where he lived and practiced medicine for several years, and where he mastered the Persian tongue besides Arabic and Syriac. He was in addition a poet who loved music, a calligrapher, and a man of letters. On returning to Baghdad he managed the famous ᶜAdūdī hospital. He also taught medicine, and his fame attracted students from near and far, so that his class at one time was attended by about fifty students. He lived to an old age and was respected for his learning, both by the ruling family and by his colleagues. He was the author of about sixteen works, most of them related to the healing arts and including brief commentaries on important medical texts.[50]

The library owns a valuable and complete copy of his formulary or antidotarium, *al-Aqrābādhīn*, in twenty chapters (Sommer, A-3, fols. 1-66a,

49. His first biography is reported by I.A. Uṣaybīᶜah, *ᶜUyūn*, 2:107-113,
واسمه الكامل الشيخ موفق‌الدين أبو نصر عدنان بن نصر بن منصور ابن العين زربي وانظر للتفصيل مقالتي « الطبيب العربي ابن العين زربي وأبحاثه في العلل والعلاج » تحت النشر ١٩٧٧ مع أبحاث الندوة العالمية لتاريخ العلوم عند العرب بجامعة حلب ، سورية ، وأيضاً د. سلمان قطاية ، مخطوطات حلب ، ١٩٧٦ ، ص‌ص ٣٣٨–٤٢ .

50. Qifṭī, *Tarīkh*, pp. 340-42; I.A. Uṣaybīᶜah, *Uyūn*,1:259-276; Brockelmann, *GAL*,1:642;*Supplement*, 1:891; Leclerc, *Histoire*, 2:24-25; and Iskandar, *Catalogue*, 78-80.
وهو أمين الدولة ابو الحسن هبة الله بن ابي العلاء صاعد بن ابراهيم ابن التلميذ أوحد زمانه في صناعة الطب وحواشيه على الكتب الطبية .

Most important among its commentaries is the one by the philosopher-physician Abū'l-Walīd Muḥ. b. Aḥ. b. Rushd (Latin Averroes, 1126-1198). It contains two parts: theory and practice, and was composed upon the request of Ibn Rushd's generous patron Abū'l-Rabī^c b. al-Sayyid A. Muḥ. al-Manṣūr, the Muwaḥḥid Caliph of Morocco (reigned 1184-1199). Ibn Rushd considered that the *Canticum* presents the best available definitions of the healing art's general themes. He embarked on its interpretation in detail (see Sommer, A-59, p. 316).

Later on, Aḥ. b. al-Ḥasan al-Khaṭīb of Constantinople completed in 712/1312 an *Urjūzah* in 320 verses. There is another by Muḥ. b. Ism. b. Muḥ. in 988/1580, following Ibn Rushd's example. Ibn al-Rafīqah (or Raqīqah) al-Shībānī (d. 635/1237) composed a brief *Canticum* on phlebotomy.[47]

Finally, deserving of mention is a commentary in the library's collection erroneously ascribed to Madān b. ^cAbd al-Raḥmān al-Qawsūnī al-Miṣrī (d. after 1634, Sommer, A-24, p. 305). This very interesting medical commentary entitled الجوهر النفيس في شرح الارجوزة للشيخ الرئيس was written by the physician al-Shaykh Mūsā b. Ibrahim b. Mūsā b. Muḥ. al-Baladāwī, a Shāfi^cite Muslim theologian who died shortly after 770/1368. He was the author of other medical works, on fevers, eye and skin diseases, and surgery.

The present copy is dated 11 Sha^cban, 892/1487. In the introduction, the author speaks of the noble profession of medicine, the greatness of the Creator and His wisdom as revealed in His handiwork, the intricacy of human anatomy, and the harmony and beauty of its constitution and function. In view of the human need of medicine, this profession he presumed, "must have started since Adam's time".

In it Baladāwī devotes a brief section to an adequate biography of Ibn Sīnā and a list of his medical contributions: Epistles on Oxymel السكنجبين ; on alchemy; on colitis القولنج ; cordial drugs, and *al-Qānūn*. He laments the poor performance of Ibn Sīnā in his *al-Shifā'* وليته لم يصنفه (الشفاء) , but admires his *Urjūzah*. Hence he attempts in the above-mentioned commentary to interpret its contents adequately.[48]

Ibn al-^cAyn Zarbi (d. 548/1153 *)*

A socio-medical revival swept over Iraq, Syria, Egypt and North Africa under the Nurid, Ayyubid, and early Mamluk dynasties with widespread

47. He is possibly Ibn A. Uṣaybi^cah's senior contemporary physician, al-Shaykh Sadīd al-Dīn Maḥmūd b. Raqīqah, ^c*Uyūn*, 1:253, 267, 290-1, 300 and 2:167. But al-Khaṭīb should not be confused with al-^cUthmānī (fl. 780/1378) mentioned in Brockelmann, *Supplement*, 2:107-8.
واسمه الكامل صدرالدين ابوعبدالله محمد بن عبدالرحمن بن الحسين القرشي الخطيب العثماني الشافعي.

48. موسى بن ابراهيم بن موسى بن محمد البلداوي المتطبب الشافعي المتوفي بحدود ٧٧٠ هـ ١٣٦٨ م وله بجانب الجوهر النفيس ، الرسالة النورية في أمراض العين الكلية ، وكتاب الحميات ، وكتاب الفتوح في علاج الجروح في الطب ذكرها البغدادي في هدية العارفين ، ٢ : ٤٨٠ وفي ذيل كشف الظنون ، ١ : ٣٨٥ .

indigestion for which various enemas and electuaries are prescribed.[44]

The library also houses an epistle on hygiene ascribed to Ibn Sīnā (Sommer, A-73, p. 321), mentioned under several titles (Printed at Cairo, 1305/1887).
تدارك أنواع الخطأ (خطأ الحدود ومطابقته) الواقع في التدبير الطبي (تدبير الانسان) او دفع المضار الكلية عن الابدان الانسانية .

It was written at the request of his generous and noble patron, Abu'l-Ḥasan (Ḥusayn) Aḥ. b. Muḥ. al-Sahlī the wazīr of Prince ʿAlī b. Ma'mūn b. Muḥ. al-Khwārizmshāhi (reigned 997-1017), to whom it was dedicated. It comprises six treatises:

1. On correcting errors committed in earlier texts regarding the therapy and medical treatment of healthy, moderate temperaments.

2. On the effects of clean or polluted air on health and the spread of pestilence.

3. On bathing as one phase of moderate, healthy exercise.

4. On suitable useful diets for maintaining good health.

5. On the suitability of drinking various kinds of wines and waters for health.

6. On suitable work, physical activity, and exercise for health.

The copy ends abruptly here, while I. A. Uṣaybiʿah mentions seven treatises in this work.[45]

One of Ibn Sīnā's authentic medical works which played a role in influencing medical teaching and development, not only in the East but in the West as well, was his *Canticum* الارجوزة في الطب . It was easier to keep by heart than his *al-Qānūn*, and eventually because of its wide-spread use and its commentaries, a new tradition was established in Islamic medicine (see *arājīz*, Sommer, A-34, pp. 308-9). Although the poetry is occasionally mediocre and artificial in style and choice of expression, a good number of copies are extant, a proof of its continued popularity.[46]

مطلع الارجوزة : الطب حفظ صحة برء مرض من سبب في بدن منه عرض
وآخرها : وقد فرغت من جميع العمل والآن أقطع بقول مكل

44. *I. A. Uṣaybiʿah*, *ʿUyūn*, 2:19-20; Iskandar, *Catalogue*, pp. 170-71; and Brockelmann, *Supplement*, 1:812;
وشبوح ، فهرس الطب ، القاهرة ، ١٩٥٩ ، ص‌ص ١٤٩-١٥٠ .

45. *Ibid.*, pp. 96-97; I.A. Uṣaybiʿah, *Uyūn*, p. 19; Leclerc, *Histoire*, 1:466; Brockelmann, *GAL*,1:589; and *Supplement*, 1:812; Iskandar, *Catalogue*, p. 94; and دفـــــــع المضار الكلية ١٨٨٧ ،
ومصطفى حاجي خليفة ، كشف الظنون عن أسامي الكتب والفنون ، طبعة اسطنبول ١ : ٣٨٠ ، ٧٥٧ .

46. *Ibid.*, 1 : 36; وذكره الاب قنواتي في مؤلفات ابن سينا ، القاهرة ، ١٩٥٠ ، ويحيى مهداوي ، فهرست مصنفات ابن سينا ، طهران ، ١٩٥٤ ، وشبوح ، فهرس الطب ، ٩-١١ ؛ ومنه مخطوطات في مكاتب عدة ، وقد نشر الارجوزة مع ترجمة وشرح جاهيير ونورالدين في الجزائر ، ١٩٥٦ ، ١٩٦٠ م.

dent observations as seen in his discussion of embryology and pediatrics.[41]

The library owns a commentary on *al-Qānūn*, ascribed by Sommer, A-62, p. 317, to Ḥakīm ʿAlī b. Kamāl al-Dīn Muḥ. al-Jīlānī (d. 1609). It is doubtful if this belongs to the latter or that it is only on the first book of *al-Qānūn*. This incomplete copy contains, in addition, a commentary on Book II. The margin carries, as well, a commentary on *al-Qānūn* by ʿIzz al-Dīn Muḥ. b. al-Amulī (d. 735/1852), also the author of a book on the classification of sciences, arts, religion and philosophy نفائس الفنون في عرائس العيون in Persian.[42]

Another work of Ibn Sīnā in the collection is his book on the kinds and treatment of colitis القولنج أنواعه ومداواته accurately described by Sommer, A-55, p. 315. It was dedicated by the author to the library of his generous and ambitious patron, Prince Aḥmad Naṣr al-Dawlah (reigned in Mayyāfāriqīn and Diyār Bakr, 401-453/1010-1061).[43] In its three treatises, Ibn Sīnā deliberates on the causes, types, diagnosis, and symptoms of colic pains. It seeks to recommend ways to prevent their reoccurrence — the acute abdominal pains from which he suffered and died on the way to Hamadān.

Here the author mentions three functional systems involved in the construction and replenishment of the body, and their connection with colitis.

1. Alimentation, to maintain the body's natural faculties which originate in the stomach and the liver.

2. Nourishment of the spirit, to maintain its animal faculties, originating in the heart and lungs.

3. Nutrition for the soul, to maintain psychic faculties and sensory motor functions, originating in the brain and in the nervous system.

In the light of these classifications, he defines colitis as a painful organic disease, a mechanical inflammation in the large intestine (colon) caused by unnatural constriction. The malady appears in five types : verminous, due to the presence of intestinal worms; windy, due to distention of the bowels from air or gas; humorous (or flatulent), due to the access of one of the four humors (mainly bilious); crapulent (or mucous), due to excess in eating and drinking; and intestinal (possibly hepatic inflammation), due to swelling or

41. *Ibid*, p. 106; Brockelmann, *GAL.*, 1:485 and *Supplement*, 1:887; and I. al-Baghdādī, *Hadiyyat al-ʿĀrifīn*, Vol. 2, Istanbul ed., 1955, p. 71;
وشبوح ، فهرس الطب ، ص ص ١٢–١٣ ، البيهقي ، تاريخ حكماء الاسلام ، ص ص ١٣١-٢ وفيها ذكر موت شرف الدين ابو عبدالله محمد بن يوسف الأيلاقي في سنة ٤٦٠ ه .

42. *Ibid.*, 2:1966; Hamarneh, *Ẓāhiriyah*, 281-84; and Brockelmann, *Gal.*, 1:638 and *Supplement*, 1:887.

43. The patron was Naṣr al-Dawlah (Allah) b. Marwan al-Kurdi al-Hamidi, an ambitions, worldly, and firm ruler. See Ibn Khallīkan, *Wafayāt*, *op. cit.*, 1:177-78 and 5:127-8; Qifṭī, *Tārīkh*, p. 418.

easier to mix, prepare, or manipulate, as in cooking, burning, washing, pulverizing, mixing, dissolving and making infusions. A final section is focused on the processes of collecting different varieties of drugs from plant, animal, and mineral origins, which are to be securely kept and preserved for future use. Two, on qualities of already known and tried simples, are arranged in twelve charts. The simples and their compounds range from medicated cosmetics, with their dermatological clarifying and beautifying effects, to those which are potent, or toxic, and should be handled with care such as aconite, henbane, opium, colchicine, and litharge. Each chart is further divided into sixteen columns on identification of simples, choice, quality, action, diseases and fevers for which these drugs are specific, and so on.

The major part of Book Two, however, is concerned with physical properties and pharmacological effects of the individual simples of the materia medica, arranged according to the Arabic alphabet into 28 sections.

Book III: on diseases of body organs from head to foot, with anatomical and physiological data that overlap with that in Books I and IV.

Book IV: on fevers, acute diseases, plagues, delirium, prognoses, crises, swellings, pustules and ulcers, surgery, and setting of fractured and dislocated bones. Similarly to Book II, it discusses poisons and antidotes, medicated cosmetics, and dermatology.

Book V: on the need for preparation techniques and pharmaceutical forms of compounded drugs such as ointments, syrups, powders, tablets, electuaries including theriacs, inhalants and dentifrices and their therapeutic uses in one ailment or another with brand named cures. It ends with a chapter on weights, volumetric measures and balances. In this book, Ibn Sīnā relied heavily on Syriac as well as on Greek sources that were available in Arabic.[40]

A great admirer of Ibn Sīnā's medical writings after his untimely death, was his countryman al-Sayyid Sharīf al-Dīn Abū ᶜAbd Allāh Muḥ. b. Yūsuf al-Ilāqī (born, possibly of Arab stock, in Ilāq near Nīsābūr, Iran and died about 1092). Sommer, (A-83, 3, fols. 181-261, p. 325) erroneously refers to him as M. b. ʿAlī al-Ailaqi who died in 1141.

Ilāqī seems to have been directly influenced by Ibn Sīnā's writings in his two known books: *al-Asbāb wa'l-ᶜAlāmāt* which in turn influenced al-Samarqandi, and his condensed version of *al-Qānūn* invariably entitled

اختصار كتاب القانون او الفصول الايلاقية في الكليات الطبية او كتاب متن ايلاقي .

copied in 1087/1676 by Aḥmad b. Jaᶜfar at Iskandar (?). This brief compendium is not entirely a condensation of *al-Qānūn*, but contains indepen-

40. Iskandar, *Catalogue*, pp. 27-32, 156-65; Hamarneh, *Ẓāhiriyah*, pp. 121-27; 262-85; and *British Library*, 1975, pp. 93-105.

the Samanid capital in Transoxiana, Nuḥ b. Manṣūr (365-387/976-997) became ill. Several physicians tried to help him, but his condition got worse. Ibn Sīnā helped to cure him, and as a result he was appointed to the court. There(997-998), he made good use of the rich royal library and its treasured, important, and rare books. After his father's death, Ibn Sīnā left Bukhārā and travelled to several cities until he came to Jurjān. There he wrote a few books and started his work on the first book of *al-Qānūn*, his best known and most comprehensive medical encyclopedia. He continued to work on it at intervals in Rayy, and finally completed it in Hamadān in five books.[38]

Significantly, the library possesses a complete copy in five books of Ibn Sīnā's *al-Qānūn fī al-Ṭibb* in 491 folios, Sommer A-53, p. 315. This impressive work constitutes a clear and orderly *Summa* of the entire healing art then known in Islam.[39] It was compiled upon urgent requests from friends who asked him to compose a concise and understandable compendium "on the general and specific rules, regulations and definitions of medicine,... the art which deals with the conditions of the human body in sickness and in well-being, to preserve health to the healthy and to restore it when lost."

Book I : known as *al-kullīyāt* because it deals with didactic, natural medical generalities, the elements, humors, spirits, anatomy and physiology, and the six hygienic principles such as air, food, rest and emotional expression. Other topics discussed are diseases, their causes and diagnosis, mother and child health, physical and diet therapy, and provisions for travelers.

Book II: on materia medica, is in two parts: One on the natural laws and medical regulations which govern drugs; their usages, temperaments, experimental testing as well as the comparing of colors, smell, and solidity characteristics, and their general and specific pharmacological effects. Thus a drug can be classified as lithodialytic, calefacient, diuretic, refrigerant, discutient, menorrhagic, cathartic, vesicatory, emetic, demulcent, corrosive, and narcotic. A section is also devoted to poisons and their antidotes. It further discusses processes applied to simples to render them more effective and

38. Ibn Sīnā's *al-Qānūn* was first printed at Rome, 1593; then at Cairo in 3 vols., Būlāq, 1294/1877; Lucknow, al-Nāmī, 1905; and the first book in Tehran, Iran, 1284/1867. It is also extant, complete or in part, in numerous copies in the original and also in Hebrew, Latin, Persian, and Urdu versions. It was tranlated into English in part (most of book I) by O.C. Gruner and M.H. Shah. Presently, it is reported as under translation at the Institute of History of Medicine and Medical Research at NewDelhi, India (Hakeem Abdul Hameed, President). See Brockelmann, *GAL*, 1: 589-99; and *Supplement*, I: 812-28 and 833-34.

39. Ẓahīr al-Dīn al-Bayhaqī *Tarīkh al-Ḥukamā*ᵓ, Damascus ed., Arab Academy, pp. 52-72; Qifṭī, *Tarīkh*, Leipzig ed., pp. 432-26; I.A. Uṣaybiᵓah, '*Uyūn*, 2:2-21; Aḥ. b. Khallikān, *Wafayāt al-aᶜyān*, Vol. 2, Beirut edition, 1969, pp. 157-62; Lucien Leclerc, *Histoire de la Médecine Arabe*, Vol. 1, 1876, pp. 466-77; G.C. Anawati, "Études avicéniennes," *Rev. Thomiste*, 61 (1961), pp. 109-35; S.M. Afnan, *Avicenna, His Life and Works*, London, Allen and Unwin, 1958; A. Soubiran, *Avicenna, Prince des Médecins*, Paris, 1935; and William E. Gohlman, *The Life of Ibn Sina*, Albany State University of New York Press, 1974, pp. 25-94.

encyclopedia, *al-Ḥāwī fī al-Ṭibb (Liber Continens)*. The author died before putting on the final touches, thus the work lacks organization. In it, the author condenses much of the Greek, Persian, and Indian medical legacies, presents resumés of ninth-century Arabic knowledge of the healing arts, and conveys his personal, clinical, and theoretical observations and experimental data. His own ideas and innovations are easily identified, since he inserts the saying "mine" or "I say" (لي) before such information.

Translation into Latin of the entire book of the *Continens* was completed about 1279,for King Charles of Anjou by the industrious scholar Faraj b. Salim (Farraguth) of Sicily. Its printed Latin edition was the first of its size on the topic to appear, in Brescia, 1486, a token of the high reputation it enjoyed in fifteenth-century European medical circles.[36]

Significantly, a copy of *al-Ḥāwī*, Sommer A-17, p. 302, dated the 19th of Dhū al Qaᶜdah, 487/1094 is the library's oldest possession. Owned by members of a single family in al-Najaf, Iraq, for many generations, it was sold in Europe, and then in 1940 to the National Library of Medicine, where it is presently on display. It contains only part three of *al-Ḥāwī*, on the conditions of the esaphagus, stomach, and intestines and the diseases that infect these and related organs of the digestive system.

Another copy of *al-Ḥāwī* is housed in the library, purchased from L.M. Saᶜidi in 1962. Copied by a certain Lutf Allāh in small, elegant Naskh (34 lines per page), it is dated the 8th of Muharram, 885/1480 (unfortunately, folios of this, like other manuscripts in the library's collection, are not numbered so that it is not easy to refer to a page or pages for citation). Besides a table of contents, this important copy comprises three discourses of *al-Ḥāwī*: on compound drugs; materia medica, pharmacy, medical deontology; and professional ethics and advice.[37]

Abū ᶜAlī Al-Ḥusayn b. ᶜAbd Allāh ibn Sīnā

The tenth century was one of the most productive periods in Arabic medicine throughout the Islamic domain. At the outset of the eleventh, the star of Ibn Sīnā (980-1037) began to shine brightly, not only in philosophy and metaphysics, but in medicine as well. He found the study of the healing art easy, pleasant, and rewarding, and excelled in it already at the age of sixteen. He was a theorist who spent his youth in the study of useful books. And it came to pass, before he was eighteen, that the sultan of Bukhara,

36. Rāzī's *al-Ḥāwī fial-Ṭibb* was edited at Hyderabad, Osmania Or. Publ. Bur., in 23 parts, 1955-1972. For a comparison between the two famous medical compendiums: *al-Ḥāwī* and *al-Qanūn*, see Iskandar, *Catalogue*, pp. 1-32.

37. For a detailed discussion of pharmacy and toxicology in *al-Ḥāwī*, see Moḥ. Muṭīʾ Kanawātī, *Ar-Rāzī Drogenkunde und Toxikologie im Liber Continen*, doctoral dissertation, Philipps-Universitat, Marburg-Lahn, published 1975; and Hamarneh "The Pharmacy and Materia Medica of Bīrunī and Al-Ghāfiqī," *Pharmacy in History*, 18 (1976), p. 4.

it exhales on contraction." He adds that, "the lungs are connected with the heart." Finally, he speaks of fevers as being as diseases not caused by other ailments, or syndromes of morbid states.[32]

Another work of al-Razi which is represented in the library's collection is the short essay on healing within one hour برء الساعة designated by Sommer as A-84 (4), fols. 44-46, pp. 236-7 (copy incomplete). This brief text on common ailments that can be healed in a short time contains simple recipes of cures for colds, headaches, toothaches, and hemorrhoids. The purpose is to save patients the time, effort, and expense that may be incurred by unnecessary and frequent visits to the doctor's clinic or for his house calls. In the modern period, it seems not dissimilar in approach to "domestic medical advisor's texts", branded home remedies, and patented medicines.[33]

One of Rāzī's widely known and greatly influential books is his *al-Ṭibb al-Manṣūrī* (Liber Rhazes ad Almansorem), named after his patron, the governor of Rayy, the Samanid prince Abū Ṣalih Manṣūr b. Isḥāq b. Aḥmad b. Asad (reigned 290-296/902-908). Intended for practitioners and students, this manual comprises ten treatises encompassing the general aspects of the healing art: anatomy and physiology, physiognomy, temperaments and humors, drug and diet therapy, preventive medicine and environmental health, ecology, medical cosmetology, toxicology and potent drugs in which opium is considered among the poisons, fevers, and minor surgery including bone setting and the treatment of wounds.[34] He emphasizes healthy dwellings and habits, psychic therapy, and immediate medical care before a disease condition worsens. He advises the use of the toothbrush *(siwāk)* to keep teeth and gums clean and strong and to refresh the mouth taste. He warns against the deceitful tricks of, and blind confidence in uncultured physicians and charlatans مخاريق المشائين. They pretend to be able to cure epilepsy by cleverly cutting a cross-shaped split in the middle of the head, or to heal eye and ear ailments by using sleight of hand tricks, deceiving patients and their families by exhibiting previously fetched substances they claim were the causes of these ailments.[35]

A much larger work than *al-Manṣūrī* is Rāzī's comprehensive medical

32. وكتب الطبيب الفيلسوف موسى بن عمران بن ميمون القرطبي كتاباً ايضاً بعنوان الفصول في الطب نقل فيه عن ابن ماسويه والرازي والفارابي ومنه نسخه في برنستون تم نقلها ١٢٨٢/٦٨١ وقد طبع هذا الكتاب في بولونيا ، ايطاليا سنة ١٤٨٩ م.

33. Iskandar, *Catalogue*, *op. cit.*, pp. 90-92; and Hamarneh *British Library*, *op. cit.*, p. 53; and *Bibliography on Medicine and Pharmacy in Medieval Islam*, Stuttgart, 1964, p. 88. It was edited with translation and commentary in French by P. Guigues, *La guérison dans une heure*, Beirut-Paris, Catholic Press, 1904. Several other extant copies are also known.

34. Rāzī's *al-Manṣūrī* was first translated into Latin by the twelfth - century Gerard of Cremona and was first printed at Milan in 1481. Several editions followed. See Sarton, *Introduction*, 1:609-10.

35. Albert Dietrich, *Medicinalia Arabica*, Göttingen, Vandenhoeck and Ruprecht, 1966, pp. 45-55; Hamarneh, *Ẓāhirīyah*, pp. 86-89;

والبرت اسكندر ، « محنة الطبيب الرازي » ، المشرق ، ٥٤ (١٩٦٠) ، ص‌ص ٤٧١–٥٢٢ .

The library's collection contains a copy of his important manual on medical aphorisms, *al-Fuṣūl fī al-Ṭibb*, listed by Sommer as A-88, fols.1-49, p.237. The copy exhibits a few spaces for words and phrases left blank. In writing it, al-Rāzī aimed at putting together what would be regarded as necessary information for medical students. Following the style of the Hippocratic *Aphorisms*, without being ambiguous or redundant, he presented his medical data as a convenient introduction to the healing art.[31] He begins by discussing the elements. To him they are simple products such as vinegar, honey, and oil, from which compounds are made. He then divides "bodies" into four kinds:

1. Heavenly bodies, such as the planets and stars.
2. Minerals, such as gold, silver, and precious stones.
3. Plants, as palm and olive trees, and
4. Animals, as man, the horse, and the lion.

He considers the human body as made of three categories:

1. Spirits, which are the vapors.
2. Liquids, forming the four humors: blood, phlegm, and yellow and black bile.
3. Solids, including skin and bones.

In his hygienic instructions, he recommends moderation in exercise, bathing, slumber and wakefulness, and diet. He further describes laxatives, vomit inducing drugs, diuretics, and fermented wines, a topic on which he had written an independent book. He defines disease as a situation in which an organ is not able to perform its function properly, or is too weak to do it effectively, or it suffers pain and lassitude in trying to do it. He further divides causes of diseases into two: changes in shape, or changes in temperament, an explanation that is fully detailed in Rāzī's two discourses on the classification of diseases and their symptoms. جوامع العلل والاعراض . These seem better organized than Galen's work on the same topic. Interestingly, in discussing internal diseases, Rāzī emphasizes the value of dissection and the knowledge of anatomy — topics that were fully treated in his medical compendium الجامع الكبير . There he emphasizes the clinical importance of urine testing in revealing the condition of the blood. The specimen should be taken in the early morning before the patient has had anything to eat. The urine indicates the state of the liver, just as the pulse reveals the heart's condition. He marvels at "the wonderful power in the arteries, causing them to expand and contract automatically throughout life; and the heart, from which pulsation flows into the arteries, it being also aerated at expansion by drawing cold air from the lungs, which

31. Rāzī's *al-Murshid*
كتاب المرشد أوالفصول مع نصوص طبية مختارة، لأبي بكر محمد بن زكريا الرازي، تقديم وتحقيق البرت اسكندر، المجلد السابع من مجلة معهد المخطوطات العربية ، ١٩٦١ ص‌ص ١—١٢٥ .

botany, materia medica and the electuaries and theriacs. We likewise find a quotation from al-Tamīmī's informative letter addressed to his father, ᶜAlī b. Muḥammad.

Why all this attention to theriacs, one asks? It was to seek safety from the ever-present menace of poisoning — either by venomous creatures or from poisonous substances. Poisons were often mixed with food or drinks or applied to objects by insidious enemies. Experienced healers were called upon to provide remedies that would counteract poisons — the theriacs which were thus transmitted from generation to generation for almost two millennia.[29]

Through Islamic influence, the fame and use of the theriac spread in Europe and reached its zenith in Italy in the sixteenth century, where the physician Pietro Andrea Mathioli prepared a treacle that comprised more than one hundred drug simples, including precious stones. And despite controversies that arose regarding the treacle's miraculous healing virtues, it was prescribed by the most learned physicians in Europe, and used by the most notorious charlatans as well. The treacles soon became lucrative articles of trade, with famous exporting cities like Venice, Padua, and Nuremburg. Considerable pomp and ceremony grew up in association with their preparation. The utmost care, nostalgic interest, and vigilance were practiced by leading apothecaries and physicians during these official ceremonies, unknown in Islam.

The Maturing of Islamic-Arabic Medicine

As a result of the ninth-century intellectual activities in translation, teaching, and productivity, Arabic medicine and pharmacy reached the stage of maturity. A golden age was ushered in with an impetus that continued for generations. Decline and stagnation set in at the close of the Middle Ages.

The stage at the beginning of the tenth century opens on a towering figure in the history of medicine and allied sciences, Abū Bakr Muḥ. b. Zak. al-Rāzī (of Rayy, near modern Tehran in Iran, 865-925). He was accorded high esteem as a physician-philosopher even during his lifetime, and his writings enjoyed the respect of practitioners in Islam and Christendom up to the Renaissance. Although he criticized certain discrepancies and errors in Galen and other ancient writers, he held Greek medicine and philosophy in high esteem, as is evident from his writings. He also added substantially to the theory and clinical applications of the healing arts.[30]

29. Hamarneh, *Origins of Pharmacy and Therapy in the Near East*, Tokyo, the Naito Foundation, 1973, pp. 110-115.

30. Ibn al-Nadīm, *Fihrist*, pp. 429-34, 454, 518; I.A. Uṣaybiᶜah, *ᶜUyūn*, 1:309-321; Carl Brockelmann, *Geschichte der arabischen Litteratur*, Vol. 1, Leiden, Brill, 1943, pp. 267-71 and *Supplement*, 1:417-21; Sezgin, *Geschichte*, 3:274-94; Aḥmed Moḥ. Mokhtār, *Rhases Contra Galenum*, Bonn, doctoral dissertation at the University, 1969; S. Pines, "Rāzī critique de Galien," *Actes VII, Congr. Internat. d'Hist. Scien*, 1953, pp. 480-87;
والبرت زكي اسكندر ، « الرازي الطبيب الاكلينيكي ونصوص من مخطوطات لم يسبق نشرها » ، المشرق ٥٦ (١٩٦٢)، ص ص ٢١٧-٢٨٢ .

In Islam, the first known translation of this Galenic work was by Yaḥyā b. Biṭrīq (not Grammaticus) in the early ninth century. Thereafter, Ḥunayn devoted a chapter to it in his *al-Masā'il*, explaining that he possessed a Greek copy of the theriac, but that it was full of errors. He made a tentative Syriac translation, then ʿIsā b. Yaḥyā translated it into Arabic for the Wazīr Abū Mūsā al-Kātib. It was afterwards corrected by Abū Sahl ʿAbd Allāh b. Isḥāq. Ḥunayn is also reported to have written two treatises to interpret what Galen had said of the Theriac.

A three folio fragment of the Greek Theriac is found in the Library (Sommer, A-3, 2, fols. 66b-69b, p. 298). In discussing the techniques of preparing the recipe, the author mentions the need for a six month period to allow theriac to mature. He also reports how long it can be kept without losing its virtues and usefulness.[28]

The Library houses another important manuscript on the same topic, entitled جامع الافتراق او الافتراق والاتفاق لصناعة الترياق , by Mahadhdhab al-Dīn Abū'l-Ḥasan ʿAli b. ʿAbd al-ʿAẓīm al-Anṣārī of Moorish Spain. This impressive and comprehensive manual represents the highest expression and culmination of all Arabic writings on the topic. The elegantly inscribed copy with its 35 chapters was completed on the 15th of Muḥarram 669/1270, shortly before the author's death. Here al-Anṣārī discusses the origin of the theriac episode and how authors agreed upon its final, correct recipe. Besides the Greek sages who were associated with its formulation, he mentions Arabic authors who had also written on it, such as Ḥunayn, al-Rāzī, Ibn Samajūn, Muḥ. b. Aḥmad b. Saʿīd al-Tamīmī, al-Zahrāwī, Ibn Sīnā, Ibn al-Bayṭār, and finally his senior contemporary ʿAlī b. Yūsuf b. ʿAbd Allāh al-Tanūkhī of Jerusalem, known as Ibn al-Ṣūrī. To each of these authors, Anṣārī gave due credit for the modifications and corrections of inherent errors, their motivations for writing, and their aims, with useful quotations from their introductory remarks. From such reports we have gained insight into the methods and techniques of preparing the theriacs, the dosages, materia medica, and substitute drugs, the testing of their effectiveness by rational experimentation, and the lead, gold, iron, and glass utensils used in the manufacturing laboratories of apothecary shops. Anṣārī mentions a theriac he made for the Ayyūbid king ʿIsā al-Maʿaẓẓam as early as 626/1229. From Anṣārī we obtain insight into Ibn al-Ṣūrī's lost book entitled الكتاب الأشرف في صفة (صنعة) الترياق المنقذ للنفوس الشريفة من التلف , on medical

28. Arabic pharmaceutical literature is enriched with material on theriacs from Greek, Indian and indigenous sources; see George Sarton, *Introduction to the History of Science*, Baltimore, Md., reprinted 1950, pp. 261, 306; Hamarneh, *Index Mss. in the Ẓāhiriyah*, pp. 50-52; 221-224, 513-16; and
ابراهيم شبوح ، فهرس المخطوطات المصورة ، الطب ج٣ معهد المخطوطات ، القاهرة ، ١٩٥٩ ، ص‌ص ٤٥–٨٤٦ .
وكتب في الترياق لمكتبة الوزير شرف الدين ، الطبيب ابن الصوري وابم ابيه رشيدالدين ابو علي منصور بن ابي الفضل بن علي وهو تلميذ احمد الغافقي الاندلسي . انظر ابن ابي أصيبعة ، عيون الأنباء ، ٢ : ٢١٦ – ٢٢٠ ، ٢٤٢ .

Sanskrit).[25] The second part discusses its therapeutic uses, especially to restore the memory. Yūḥannā b. Māsawayh (d. 855) recommended mixing the drug with hot butter for use against amnesia. Ibn Sīnā considers it efficacious for physical impediments *(al-zamānah)*, stating that it helps to clear the mind, and prevents madness and delirium. In this part, the author further elaborates upon the techniques by which the juice of these nuts, *ᶜasal al-Balādhur*, is extracted, collected and then used medicinally.[26]

The Theriacs or Antidotes (Treacles, L. Theriacae)

One of the celebrated themes of medieval and renaissance therapy was the festive preparation and utilization of the "great theriac, al-Tiryāq al-Fārūq" arabized from the Greek *thériaké*. Ḥunayn explains that the word denotes an animal that bites, so that the recipe was used against animal bites, then later applied as an antidote against all types of poisoning. In Europe, it came to be used as a treacle or universal antidote. Eventually, it was applied, not only against poisoning, but as a "wonder cure" for several other diseases.

The tradition of treacle goes back to the ancient Egyptian and Greek sages who gradually augmented the number of its components and developed methods of preparation. Arabic sources attributed its origin and fame to nine consecutive Greek authors, spanning a period of over a millennium. The tradition started with Andromakhus I, and culminated in Galen, to whom four works on the subject have been attributed. They include one on the virtues, advantages, and application of the Theriac. Several titles are known in Latin: *De Antidotis*, *De Theriaca* and *Pisonem Liber*.

I. A. Uṣaybīᶜah explains how the theriac was first compounded as a mixture of honey and laurel seeds. Through divine inspiration, miraculous events, and dreams, the number of ingredients was increased. The culmination of the development was the addition of snake's flesh. After a long process of addition and deletion of ingredients, a recipe was evolved regarded as the most exact and perfect. It contained about 88 simple drugs including anise, opium, iris, casia, jusquiam, balsam, aristolochia, saffron, squill, centaury and snake meat. I. A. Uṣaybiᶜah also reports that Galen in a two-treatise book on therapeutics الأدوية القابلة للادواء devoted the first treatise to theriacs.[27]

25. It is mentioned by I.A. Uṣaybīᶜah, *ᶜUyūn*, 1:201; Ibn Sīnā, *Qānūn*, Būlāq ed., Cairo, Vol. 1, BK. 2, p. 267 and Vol. 3, BK 5, pp. 327-28; ᶜAbd Allāh b. Aḥ. b. al-Bayṭār, *Jāmiᶜ al-Mufradāt*, Vol. 1, Cairo, Būlāq ed., p. 113; and Sezgin, *Geschichte*, 3:129 with the Arabic title
مقالة في شراب ثمر البلاذر ومنفعته وتدبيره، ترجمة اسحق بن حنين مقالة منسوبة الى جالينوس

26. The marking nut tree شجر البلاذر is indigenous in the warmer regions of south-central and south-eastern Asia. It gives black, obliquely cordate nuts containing within its pericarp a black, resinous, viscid and acrid juice used in industry as a marking ink and in medicine externally as a local caustic and vesciant, and internally against rheumatic pains, flatulence, delirium and mental fatigue. See David Hooper, *Useful Plants and Drugs of Iran and Iraq*, Chicago, Field Museum, 1937, p. 170.

27. I. A. Uṣaybīᶜah, *ᶜUyūn*, 1:7,99, 197-98; Kühn, *Galeni*, *op.cit*, 14:210-310; Campbell, *Medicine*, 2:105, 145; Rāzī, *al-Ḥāwī*, Hyderabad ed., 7:162, 220, 249; and Sezgin, Geschichte, 3:121.

Transmission and Translators

The work of translation was carried forward more vigorously in the ninth than in any other century of the period. Translations into Arabic were made, not only from the Greek, but from the Sanskrit, Persian, and Syriac as well. Many competent scholars, mainly Christian Arabs from Syria and Iraq, participated in this effort. As regards the healing arts in particular, the outstanding figures include the Christian Arab, Abū Zayd Ḥunayn b. Isḥāq al-ᶜIbādī, his son Isḥāq, and his nephew Ḥubaysh; Isṭifān b. Basīl; Qusṭā b. Lūqā; and ᶜIsā b. Yaḥyā. A solid foundation was established for Arabic medicine as a result of their labors and the work of their associates, to whom the health professions remain truly indebted.[23]

A unique manuscript in the collection (Sommer A-90,2, fols. 7-16) is attributed to Ḥunayn, but the name of the copyist is missing. The text refers to Galen, Ptolemy, and Hippocrates as quoted by Ḥunayn, and although the work is not listed in Ibn al-Nadīm's *Fihrist*, it has been mentioned by others. It is devoted to veterinary medicine في البيطرة and to the treatment of domestic animals في علاج الدواب . All veterinary diseases are ascribed to strangulation (asphyxia) and asthma, with the entire approach to treatment based on the humoral theory. Internal and external diseases and their treatment, either by drugs or by surgical manipulations, are discussed.[24]

A fragment in the collection is also erroneously ascribed to Ḥunayn on its title page. Sommer regards it as a part of a formulary, *Aqrābādhīn*, and as part of a treatise on healing, with the title *al-Risālah al-Shāfiyah* by Ḥunayn (Sommer A-3, pp. 297-8 erroneously calls him Ḥamīr) b. Isḥāq, written in a different hand. In fact, this manuscript is an important and rare treatise by Ḥunayn's son, Abū Yaᶜqūb Isḥāq al-ᶜIbādī (d. 911), and is mentioned by I. A. Uṣaybiᶜah. Others have suggested that it was written by Galen and translated by Isḥāq. It deals with drugs and treatment to restore health and good memory, called "On inhibiting forgetfulness (amnesia)", under the general title مقالة في الأشياء التي تفيد الصحة والحفظ وتمنع من النسيان . Isḥāq wrote it for his patron ᶜAbd Allāh b. Shamᶜūn in the late ninth century. The first part centers on a discussion about the various methods, techniques, and instruments used in extracting the resinous, viscid juice from the nuts of anacardium (marsh nut or the marking nut tree, *Semecarpus anacardium L.*, *bhela* or *bhilava* in

23. Ibn al-Nadīm, *Fihrist*, pp. 345-56, 414-29; Gotthelf Bergsträsser, *Ḥunain ibn Isḥāq Über die syrischen und arabischen Galenübersetzungen*, Leipzig, 1925; Ullmann, *Die Medizin*, *op. cit.* pp. 100-119; Carl Brockelmann, *Geschichte der arabischen Litteratur*, Vol. 1, Leiden, Brill, 1943, pp. 224-27; *GAL. Suppl.* 1:367-9; Sezgin, *Geschichte*, 3:247-56; Hamarneh, *Index of the National Library*, Cairo, 1967, pp. 19-24; and A.Z. Iskandar, "An Attempted Reconstruction of the Late Alexandrian Medical Curriculum," *Medical History*, 20 (1976), pp. 235-58.

24. I.A. Uṣaybiᶜah, *ʿUyūn*, 1:201 mentions a book on veterinary medicine by Ḥunayn. This work is not mentioned by Carl Brockelmann or by F. Sezgin.

work, although its author seems to have borrowed extensively from Galen's writings. It also includes statements and quotations from Thābit b. Qurrah al-Ḥarrānī (ca. 836-901), which rules out Galen as its author. The present copy contains the second through the 33rd *maymar*. It describes in detail syndromes and diseases, including discussions on obstetrics, pediatrics, and the treatment of fevers, as well as the composition and substitution of drugs. It ends with a maymar on toxicology, all types of poisons, and the use of antidotes, and is dated in 938/1532. Organized, rational, and systematic in approach, it seems worthy of further evaluation.

Another manuscript in the collection (Sommer A-27, p. 306) contains three different works. The first part is a treatise on the anatomy and physiology of the bodily organs: head, chest, genital organs, etc. It is based on Greek anatomical information, but organized in a manner similar to that of Ibn Sīnā's *al-Qānūn*. However, the book is neither Galenic nor is it by Ibn Sīnā. It seems to be a compilation made by a certain Jewish physician, Malak Isḥāq of Damascus, possibly of the early Mamluk period. It was copied in elegant, legible Naskh at Shār Dilmān on the 5th of Rajab, 992/1584. The second part is a fragment of a medical lexicon. The third contains the second section of a certain compendium. It discusses prognostic conditions and regulations on the Galenic *crisis*, and critical days wherein the patient's case is determined—leading either to full recovery or to a relapse. Based on Greek writings, this work is, likewise, an Islamic compilation.

The Library houses still another work on anatomy and physiology (Sommer A-76, p. 322). It is a compilation intended for students, apprentices and beginners. The emphasis is on the importance of anatomy in diagnosing diseases, the relationship of affected organs to one another, and how to apply adequate medical treatment. Knowledge of anatomy also leads to a deeper appreciation of God's wisdom and omniscience. The information in the book has been gathered from familiar Greek and Arabic sources, and is organized in an introduction, two chapters and an epilogue. Although no authentic discoveries have thus far been found in such manuals, they had a definite educational value in making anatomical studies and data accessible to students and practitioners.

The last book on anatomy to be mentioned in this collection is a discourse by the physician Aḥmad b. ʿAbd al-Munʿim al-Damanhūrī of Egypt (d. 1778), entitled القول الصريح في علم التشريح . It was copied from the author's autograph original during his lifetime, in 1155/1742 (Sommer A-54, p. 315). In most cases any copy like this is supposedly more dependable than others, because it could have been read to the author for his personal approval. It represents a culmination of the knowledge of anatomy in the late period of Islamic-Arabic medicine and before the spread of modern European education.[22]

22. Basically, surgery in Islam was based on the Galenic writings, but several important additions, observations, and techniques were introduced, as is evident in the work of al-Zahrāwī, al-Mawṣilī and others whose writings influenced surgery in Europe.

of the books he authored. A century later, al-Rāzī accepted Ḥunayn's opinion of this book, which to this day is extant in several copies in Arabic, Hebrew and Latin, besides the original Greek.[19]

Another manuscript in the Library's collection, also incorrectly ascribed to Galen, is a treatise on the parts of the human constitution التقاسيم الانسانية في الصورة البشرية (Sommer A-74, p. 321). After discussing the four main parts of the body: head, hands, feet and the thoracic organs, the anonymous author discusses the anatomy and physiology of pulse, bones, teeth, nerves, blood vessels, head, chest, belly, and bladder. In addition, he describes the body's humors and the natural elements, including unrelated anecdotes and religious sayings which are hardly relevant. Therefore, this poorly organised compilation appears to be of late Islamic origin. It is marked as having once been owned and stamped by the physician Muṣṭafā Masᶜūd (dated 1213/1798). The rendering of the names of the months such as January, April, and October are transliterated from the Latin.

A similar surgical epistle in the collection also erroneously ascribed to Galen (Sommer A-56, p. 316) seems to be a summarized compilation by Muḥ. Rafīᶜ b. ᶜAbd Allāh al-Tabrīzī, who lived and practiced medicine in Isfahan, Iran. It presents a brief essay on human anatomy and physiology from the head to the genital organs and was completed on the 27th of Ramaḍān 1116/1704. Both works show definite Greek influence.[20]

A very important Galenic work which influenced Arabic medicine, pharmacology, and therapeutic techniques was his book on the composition of remedies, in seventeen treatises. According to Ḥunayn, it was divided in the Alexandrian medical curriculum into two parts – a division that persisted so that all later copies are set up as two books. The first, comprising seven treatises, contains discussions on each type of compounded drugs, such as demulcents, astringents, oxytocics, sedatives, hypnotics, and diaphoretics – a pharmacologic classification known in Latin as *De compositione medicamentorum per genera Libri VII*. The second book, comprising ten treatises, known as *mayāmīr* (plural of *maymar*), cites the correct methods for using composite drugs. In Latin it is entitled *De compositione medicamentorum secundum locus Libri X*. Manuscripts in Greek, Arabic, Hebrew and Latin are known.[21]

After a thorough examination of Sommer A-39, p. 310, it became clear that this manuscript is not identical with Galen's above-mentioned composite

19. Kühn, *Galeni*, 7:273-407, 9:550-768; Sezgin, *Geschichte*, 3:94-96, 127-28; and Rāzī's *al-Ḥāwī*, Hyderabad edition, 10:166-68 and 19:92,134.

20. Campbell, *Medicine*, 2:137-38; Manfred Ullmann, *Die Medizin im Islam*, Leiden-Köln, Brill, 1970 pp. 24-64; and Hamarneh, *Catalogue of Br. Library*, *op.cit.* pp. 16-26.

21. Ibn al-Nadīm, *Fihrist*, p. 394 and Qifṭī, *Tarīkh*, p. 119, refer to Thābit's compilation of Galen's book on materia medica. See also I.A. Uṣaybīᶜah, *'Uyun*, 1:97-99; Campbell, *Medicine*, 2:102-4; and Sezgin, *Geschichte*, 3:70, 118-19.

The original work includes seventeen treatises, and was translated into Arabic by Ḥubaysh b. al-Aᶜṣam and corrected by Ḥunayn. The fourteenth - century copy in the Library (written in elegant, legible Naskh, 15 lines per page 18 ×25 cm.) starts from the middle of the first treatise and ends at about the middle of the fifteenth — the rest is missing.

This book exposes Galen's teleological concepts in anatomy and physiology. He confirms that every part and organ in the body has the place best suited to it, where it can best perform its particular function. Interestingly, he starts with the anatomy and physiology of the hand and fingers, the structures which distinguish humans from other creatures. Because of them, the author explains, "humans are able to invent and improve on manual skills and technology." He then describes the wisdom and refinement in the makeup of the feet, the body's digestive and respiratory systems and their parts, blood vessels, head and brain, eyes, ears, face, and the rest of the human constitution. He concludes with the reproductive organs.

The text as a whole was aptly translated and highly esteemed. No student of Islamic medicine, and indeed of the health field throughout the Middle Ages, in East or West, could fail to realize its importance to the development of medical thought and practice. This is also evident by the number of extant copies, not only in the original Greek and the Arabic versions, but also in Hebrew, Latin and modern languages.[18]

Another fragment owned by the library was erroneously attributed to Galen. Its incipit reads:

رسالة وجوامع كتاب جالينوس في البول ودلائله ، أو معان استخرجها حنين بن اسحق من كتب بقراط وجالينوس في البول على طريق المسألة والجواب

Its proper title is *Jawāmiᶜ Kitāb Jālinūs fī al-Bawl wa-Dalāʾiluh*; On the Urine and Its Diagnoses (not the bubonic plague, Sommer A-84,2, fols. 41-43, p. 325) known in Latin as *De urines*. The colors of urine, the conditions and kinds of urine tested in a variety of diseases, and their diagnoses based on examination are discussed. From a section in the introduction, the anonymous author mentions three matters that form the human body: blood, spirit, and seminal fluid. The Galenic concept of the four humors is expounded, followed by a detailed discussion on urine.

Ḥunayn, in the ninth century, doubted the authenticity of this book. He asseverated that Galen wrote about the urine in his other well-known books, in particular in *al-Buḥrān* (on crisis) and *Ayyām al-Buḥrān* (on critical days), and *Fī Aṣnāf al-Ḥummayāt* (on fevers). Thus he did not need to devote a separate work to this subject. Moreover, this book is not listed in his *Index*

18. Donald Campbell, *Arabian Medicine*, Vol. 2, London, 1926, pp. 41-44; Sezgin, *Geschichte*, 3:106-8; and is edited and translated into Latin in Kühn's *Galeni Opera Omnia*, Vols. 3 and 4. See also E.D. Philips, *Greek Medicine*, London, Thomas and Hudson, 1973, pp. 172-95.

ninth century. Ḥunayn completed a Syriac translation of the entire book, but translated into Arabic only the third treatise, with Galen's commentary. The Arabic version of Hippocrates' original text, which exists in several copies, has been edited with an English introduction, translation, notes, and glossary, by Mattock and Lyons of the University of Cambridge Middle East Center.[16] A useful, brief commentary had also been made by the Egyptian physician-philosopher ʿAlī b. Riḍwān (d. ca. 453/1061).

To return to Ibn al-Nafīs, he indicates that he undertook his work with the Hippocratic book only after completing his detailed commentary on the *Qānūn* of Ibn Sīnā. In his concise commentary on *The Nature of Man*, Ibn al-Nafīs explains the uniformity and the harmony "of the four natural elements – fire, air, water and earth," and how they are corruptible within the body which "is formed by the four humors – blood, phlegm, and yellow and black bile, and of their four qualities of being hot, cold, moist and dry." These qualities are assigned to the body's organs, two for each. They form the nature of the human body in sickness and in health. He states then, that gluttony is the cause of many ills because it disturbs and corrupts the humors' equilibrium and interferes with their healthy condition. He differs from Hippocrates in considering that the body's attraction to laxative drugs is not like the penetration of the sap into the parts of the plant, but "is similar to the pull of iron to a magnet, so that each laxative purges only a certain humor. The exception is in cases where there are two or more humors mixed, usually phlegm with other humors and thus they are purged all together".

He then divides treatment into three classes, as did Ḥunayn in the ninth century: treatment by diet, by drug therapy, or by surgical manipulation. In physiology he tends to inject his own ideas, as for instance in confirming that blood vessels are formed of the same substances from which other body organs are made.

The Galenic Writings

The reverence that was given in this era to the Hippocratic Corpus was matched by a similar and perhaps even more pervasive esteem accorded the Galenic writings. Of these the most important example in the library's oriental holdings is Galen's book on the uses of the bodily organs, *De usu partium corporis humani*.[17] The manuscript was purchased in 1962 from Lutfi M. Saʿdi, M.D.

16. C. G. Kühn, *C. Galeni Opera Omnia*, Vol. 15, repr. Hildesheim, 1965, pp. 1-173; Emile Littré, *Le Oeuvres Completes d'Hippocrate*, Vol. 4, Amsterdam reprint, 1961, pp. 32-68; Sezgin, *Geschichte*, 3:37-38, 124; and Hermann Diels, *Die Handschriften de antiker Aerzte*, Part 1, Berlin, 1906, pp. 20-21. It was edited in Arabic, translated and annotated by J.N. Mattock and M. C. Lyons under the title, *Hippocrates on the Nature of Man*, as Vol. 4, Arabic technical and scientific texts series, Cambridge, England, W. Heffer, 1968; and translated from the original Greek by W. H. S. Jones, *Hippocrates*, Cambridge, Mass., Harvard University Press, 1953, pp. 1-41.

17. It was translated with useful introduction, commentary and annotations by M. T. May under the title, *On the Usefulness of the Parts of the Body*, in two Vols., Ithaca, New York University Press, 1968.

In Sommer's list also (A-84, 2, fols. 39b-40b) is a fragment of an epistle incorrectly ascribed to Hippocrates. In fact it is spurious and is generally known under various titles: *Fī al-Buthūr*, *fī ᶜAlāmāt al-Maut*, and *Fī al-Indhār bi'l-Maut*, meaning the symptoms, pimples, or pustules that indicate or serve as death signs warning the physician of imminent death, *De pustulis et apostematibus significantibus mortem.*

في الانذار بالموت ، في البثور ، في علامات الموت ، العلامات التي يستدل بها على أحوال الموت ، علامات القضايا البقراطية الدالة على الموت ، كتاب بقراط في علامات أمراض الموت المنذرة والمبشرة بذلك ، والرسالة القبرية أو قضايا بقراط .

The epistle describes pimples appearing in twenty-five cases that occur under certain conditions in which the patients show signs or tendencies to be considered as "messengers of death." It begins with the statement "Hippocrates' said", and then describes the case and his confirmation, which in most cases sounds ridiculous. One example is an account of a patient who had "a black swelling on the chest the size of an egg". If he shows a tendency to eat watermelon, and to frequent urination, "then he will die before the month is over". Another case is that of a patient having a pustule on the lower part of the neck and a white pustule on the left eyelid. If the patient lusts after sweet stuff and confectioneries "he will die in eleven days."

Ḥunayn is quoted as saying that Hippocrates, before his death from hemiplegia, requested that "a scroll with this epistle inscribed on it be placed in a small ivory chest and be buried with him. One day King Caesar passed by and was grieved to see the poor condition of the miserably neglected grave. He therefore commanded that the grave site be reconstructed in a manner worthy of the deceased. In the process, the scroll with the epistle on death signs came to light". That is how the legend has it in Arabic accounts. It was also added that Galen wrote a commentary on this epistle, but Ḥunayn doubts the truth of the tradition. Seemingly this Greek pseudo-Hippocratic epistle was translated by Yaḥya b. Biṭrīq and several copies are presently known.[15]

Of special interest is a rare and very important copy at the library (Sommer A-69, p. 320) of a commentary on Hippocrates' *The Nature of Man*, by the physician ᶜAlī b. Abī al-Ḥazm al-Qarshī known as Ibn al-Nafīs (ca. 1209 - 1288). It was copied from the author's autograph version during his lifetime (which suggests that he may have seen it). It was completed on the fourth of Rabīᶜ I, 668/1269 by the physician Abu'l-Faḍl b. A. al-Ḥasan al-Kātib.

Hippocrates' original book on *The Nature of Man*, which was authenticated by Kuehn, Littré and Jones, was commented upon by Galen in three treatises, which were translated into Arabic by 'Isâ b. Yaḥyá in the early

15. I. A. Uṣaybiᶜah, *ᶜUyūn*, 1:26-28; Iskandar, *Catalogue*, p. 173; Sezgin, *Geschichte*, 3:39-40; and S. Hamarneh, *Catalogue of the Br. Library*, 1975, pp. 1-7. It is mentioned in al-Rāzī's *al-Ḥāwī fī al-Ṭibb*, Hyderabad edition, Osmania Or. Publication Bureau, India, 1956-60, 4:196, 5:172 and 7:41.

and the first to establish a hospital to care for his patients. He lived to the age of 87 or 92 (equivalent to 90 or 95 years according to the Muslim lunar system, depending on the various Arabic sources). This was one hundred years before the time of Alexander the Great.[12]

In medieval Islam, the Hippocratic medical writings were considered the oldest to be translated into Arabic. These include *Prognostics*, *Epidemics* books I and III, *Regimen*, *The Oath*, *Nutriment*, *Airs Waters Places*, *Fractures and Joints*, *Wounds of the Head*, *Barley Water*, *Humors*, and the *Aphorisms*. The latter was held to be the most famous in Arabic. Many went so far as to claim that these sayings came by inspiration and were dictated by divine guidance. Thus they were commented upon by many authors during this period.[13]

Sommer assumed that the copy (A-66, p. 319) at the library was one of these commentaries on the Hippocratic *Aphorisms*. After comparative examination of its contents it became clear that this beautifully inscribed and vowelized copy is a commentary on the *Masaʾil fī al-Ṭibb* of Ḥunayn b. Isḥāq al-ʿIbādī (809-873). It was intended as an introductory manual to the healing art for students and beginners, and was written in the form of questions and answers. This useful commentary was done by an admirer, possibly the first known commentator on the *Masāʾil*, the Iranian physician Abu'l-Qāsim ʿAbd al-Raḥmān b. ʿAlī b. A. Ṣādiq of Nīsābūr (d. after 460/1068). In its reorganized ten chapters, Ḥunayn's questions and answers were quoted, followed by Ibn Abī Ṣādiq's elaborate commentary *(al-tafsīr)*. The present incomplete copy begins with the discussion on arteries and heart pulsation and related topics. It also contains the important section on the classification of compound drugs, and the theriacs and the laws related to their preparation, therapeutic aspects and the dosages recommended for the various diseases and conditions.[14]

12. Arabic sources convey important and useful accounts of Hippocrates. See for example:
سليمان بن حسان بن جلجل ، **طبقات الاطباء والحكماء** ، تحقيق فؤاد السيد ، القاهرة ، المعهد الفرنسي ، ١٩٥٥
ص‌ص ١٦ – ١٨ ؛ وأحمد بن واضح اليعقوبي ، **تاريخ** ، ج١ ، تحقيق بحر العلوم ، النجف ، الحيدرية، ١٩٦٤،
ص‌ص ٨١–٩٨ ؛ ومحمد بن اسحق بن النديم ، **الفهرست** ، طبعة القاهرة ، ١٣٤٨ هـ ١٩٢٩ م ص ص ٤١٢–٤١٤ ؛
وجمال‌الدين علي بن يوسف القفطي ، **تاريخ‌الحكماء** ، طبعة ليبزج ، ١٩٠٣ ص‌ص ٩٠–٩٢ ؛ واحمد بن ابي اصيبعة ،
عيون الأنباء في طبقات الأطباء ، ج١ ، طبعة القاهرة ، ١٨٨٢ ص‌ص ٢٤–٧٢ ؛ وفهـرس مخطوطات الظاهرية ،
١٩٦٩ ، ٣٨–٤٥ .

13. See Sezgin, *Geschichte*, 3:28-41; and I. A. Uṣaybīʿah, *ʿUyūn*, 1: 29-32. The Arabic version of Hippocrates' *Aphorisms*, فصول بقراط was edited at the Muqtataf Press, Cairo, 1896 in 70 pp. For impact in the West, see Pearle Kirbe and N.G. Siraisi, "Matheolus' Commentary on the preface to the Aphorisms," *Bull. Hist. Medicine*, 49 (1975), pp. 405-27.

14. I. A. Uṣaybīʿah, *ʿUyūn*, 1: 197-98; Albert Z. Iskandar, *A Catalogue of Arabic Mss. on Medicine and Science*, London, the Wellcome Institute, 1967, p. 179; and S. Hamarneh, *Index of Mss. in Ẓāhiriyah*, 1968-69, pp. 38-45, 212-220 and 451.

regarded as the highest in perfection and veracity. With few exceptions, their doctrines and teachings were considered fundamental and authoritative. The Arabic translations of their works were circulated widely and quoted extensively in medical compendia and manuals for a millennium.[10]

The Hippocratic Corpus

Supposedly about forty-five, small and large, genuine and spurious Hippocratic writings were translated from the Greek (or Syriac) into Arabic. Extant copies of such works with their Arabic titles are known. Almost three times as many titles of books or epistles have been attributed to Galen, but not all are genuine translations. Notwithstanding, these works have added color and grandeur to Islamic-Arabic medicine and they have left indelible marks on medical education and practice in the Latin West as well.

Serious translations into Arabic began with the start of the ninth century and culminated in the tenth (3rd century A. H.). Most important among the translators were Yaḥyā b. Biṭrīq, Ḥunayn b. Isḥāq al-ᶜIbādī, his son Isḥāq, and his nephew Ḥubaysh b. al-Aᶜṣam of Damascus.

Because of these translators' genuine interest in medical traditions, the life and works of Hippocrates and Galen were not unknown to Arabic readers. There is a mass of information, fact and fiction, found in Arabic chronicles and biographies. From these important sources, a meaningful picture of these historical figures and their works can be drawn. In many cases they are among the finest records available today.[11]

Son of Heraclides, Hippocrates was born, according to Arabic sources, at Qū or Qaw (Cos, Meropis or Stanchio, a small island in the Aegean Sea). Here a respectable medical school flourished, and until his death, Hippocrates helped to publicize and develop this school into a center for learning. The seventh from Askulabias I (Asclepios, the Greek founder and god of healing), he was reportedly one of three students of Askulābias II (possibly Asclepiad is meant here by Muslim bibliographers). When the first two pupils died, Hippocrates took over the leadership in teaching medicine to all qualified to learn it, lest it be forgotten. He was also considered the first among the ancient physicians to preserve and publish his own writings for the benefit of posterity,

10. Hippocrates was seldom critized by Muslim authors except for being unduly brief, sketchy and unclear. Galen however, was occasionally critized by eminent physicians such as al-Rāzī, al-Majūsī, al-Baghdādī and Ibn al-Nafīs for errors and oversight in some of his works, including anatomical texts. For biobibliographical information see Robert Joly, "Hippocrates of Cos", *Dictionary of Scientific Biography*, Vol. 6 (1972), pp. 418-431; Fridolf Kudlein and L. G. Wilson, "Galen", Vol. 5 (1972) pp. 227-235; and Ludwig Edelstein, *Ancient Medicine*, edited by O. and C. Temkin, Baltimore, the Johns Hopkins Press, 1967, pp. 112-132.

11. For a very useful and comprehensive coverage of Hippocrates' and Galen's writings in Arabic and their impact, see Fuat Sezgin, *Geschichte der arabischen Schrifttums*, Vol. 3, Leiden, Brill, 1970, pp. 23-46 and 68-149.

concise discussion portraying the relevance of the Islamic-Arabic civilization to the general history and progress of the health professions. He exposed "prejudiced ideas and attitudes against Arabic culture which invariably come from those to whom the linguistic difficulties made the science of the Arabs a closed and mysterious book."[8]

We are indebted, in addition, to Schullian and Sommer for their *Catalogue* which contained physical descriptions and identifications of all the Arabic manuscripts acquired by the Library up to late 1948, listed alphabetically by titles. It incorporated an article on the same collection published two years earlier.[9] A few corrections to this catalogue have been made in the pages which follow.

The last important addition consisted of a few manuscripts and rare books acquired in 1962 from Dr. Luṭfī M. Saᶜdī, himself an amateur of the history of Arabic medicine. These items have not been mentioned in the literature as yet. The library also acquired several important copies of Arabic medical manuscripts on microfilms or as photographic prints, but as such they are beyond the scope of this brief essay.

Transmission of Greek Medical Writings

Translators, physicians, and scholars during the first century of the Abbasid period eagerly embraced and intelligently utilized the Greco-Roman medical writings as they were rendered into the language of the Qur'ān.

Significantly, this was a time in history when the great intellectual treasures of the classical period were threatened by extinction. Preservation by the Arabs of many of these works is one of a number of ways in which this people contributed to the conservation and advance of science.

The Library's collection contains a few copies of translated Greek works attributed to the two leading authorities of the time, namely Hippocrates of Cos (460-ca. 370 B.C.) or the Corpus bearing his name, and Galen of Pergamum (A.D. 129-200). Despite a span of five centuries between these two historical figures, the medical contributions of the latter, in the Islamic view, constituted an introduction and supplement to those of the former. This view perhaps held for the entire medieval period, in both East and West. By and large, authors and educators in the health and related fields revered the writings of the Greeks, especially those of Hippocrates and Galen. Their writings were

8. Claudius F. Mayer, "The Collection of Arabic Medical Literature in the Army Medical Library", *Bulletin of the Medical Library Association*, 30 (1941-42), pp. 96-104.This paper was originally read before the 43rd annual meeting of the Association, then republished with an added "Checklist of Arabic Manuscripts," *Bulletin of the History of Medicine*, 16 (1942), pp. 201-216.

9. Schullian and Sommer, *Catalogue*, pt. 2 (1950), pp. 296-329. A preliminary account was presented by F. E. Sommer, "A New Depository of Oriental Manuscripts in the United States," in *Journal of the American Oriental Society*, Vol. 66, no. 2 (1946), pp. 183-84.

ed[4] that "the most important acquisition of this library by far (period from July 1, 1939 to June 30, 1940) has been a collection of Arabic medical manuscripts purchased from a celebrated orientalist scholar(63 Arabic and Persian manuscripts from Abraham S.Yahuda)." The letter, however, somewhat exaggerated the encompass of the purchased collection when it emphasized that "it represents the entire development of Arab medicine from Rhazes in the tenth on to the 19th century.. and the collection is unique since there is no similar one in America. Even European libraries which may possess many hundreds of oriental manuscripts usually do not have more than a dozen Arabic manuscripts of medical interest." This was of course an attempt to justify a praiseworthy purchase. To put the record straight, it should be mentioned that the British Library in London, along with a few others, held at that time over three hundred Arabic medico-pharmaceutical manuscripts, not a few of which are unique and of great historical and medical value.[5]

The facts were stated more precisely by F. Sommer on October 7, 1948, when he commented that, "A careful selection was made to secure a good cross-section of early Arabic medical literature for the (Library's) History of Medicine Division." Because of the high price and the limited library acquisitions' budget at the time, "The purchase was made in two installments and the payment was spread over several fiscal years."[6] In addition, to speed up settlement, some money from William F. Edgar's (d. 1897) bequest was used to pay off the debt. This fund was left to be expended for the benefit of the medical museum and the Library, and thus the operation was quite legitimate.[7]

In view of the significance of this outstanding Arabic collection to the history of medicine, there was an immediate and genuine interest in listing and studying its contents. The first to undertake such an important task was Claudius F. Mayer, a medical doctor who served as editor of the *Index Catalogue* and as assistant to librarian Jones. Mayer presented orally, and subsequently published, not only an annotated list of the manuscripts, but also a

4. Robert B. Downs in a letter dated October 1, 1940, wrote on behalf of the American Library Association, Board of Resources to Librarian Colonel Jones asking for information on outstanding materials added to the Library for inclusion in his annual report. A copy of H.W. Jones' reply, dated November 29, 1940 is also kept in the Library's archives.

5. See *Catalogue British Library*, 1975.One can also refer to depositories in Paris, the Vatican, Gotha, the Escorial, Oxford, Leningrad, and others.

6. References to this Arabic collection were made in the *Index-Catalogue of the Libr. Surg. General.* 4th series,Vols. 6 and 7, 1941-1942; by R.B. Downs in "notable materials added to American Libraries 1939-1940," *The Library Quarterly*, Vol. 11 (July, 1941), pp. 275, 293-94; and Dorothy M. Schullian and Francis E. Sommer, *A Catalogue of Incunabula and Manuscripts in the Army Medical Library*, New York, H. Schuman (1950), pp. 293-295. Hereafter,for brevity, since the Arabic section was edited by Sommer his name in the footnotes and text will denote this section.

7. For detailed information on the Edgar Fund see Robert S. Henry, *The Armed Forces Institute of Pathology, Its First Century*, 1862-1962, Washington, Office of the Surgeon General of the Army, 1964, pp. 234-35. This fund was used up by the end of 1957.

ed to include all members of the health professions worldwide.[2] In 1956, by an act of the Congress, it was designated as the National Library of Medicine, becoming part of the immense U.S. Department of Health, Education, and Welfare. Presently, it is the world's largest research library in medicine, and in all related health professions and allied sciences. Its holdings on medico-pharmaceutical history are equal in importance to the finest and most accessible in our time. The Library's oldest volume is a copy of a part of al-Rāzī's (Latin Rhazes, 865 - 925) famous medical encyclopedia *al-Ḥāwī fī al-Ṭibb* (Continens) dated 487/1094. Other Arabic manuscripts in the collection date among the earliest, and constitute a real literary treasure.

In 1942, the Arabic collection, along with other manuscripts, rare books and incunabula of the then Army Medical Library was transferred to Cleveland, Ohio, for protection and safekeeping during World War II. At their temporary quarters, they were systematically restored, catalogued, and preserved for over two decades.

In 1960, it was my privilege to inspect the Arabic collection at Cleveland for the first time. But I had better access to it after it was returned in 1962 to the Washington area for safer keeping in the then recently completed, air-conditioned building of the National Library of Medicine located at 8600 Rockville Pike, Bethesda, Maryland.

The collecting of Arabic manuscripts was a rather recent development, which began after the first quarter of this century. As was frequently the case with subjects regarded by many as exotic, they were obtained not through projected design and active planning, but by chance donations or small purchases.

The largest and most significant collection of Arabic manuscripts, plus a few in Persian, was acquired in early 1940 by the Librarian, Harold W. Jones (1877-1958), Colonel of the U.S. Army Medical Corps. As a consequence of his enthusiasm for what is considered today a very significant and invaluable collection, he seems to have been talked into buying its sixty-three volumes for about four thousand U.S. dollars — a large sum of money when compared with the then meager budget for library acquisitions (total acquisitions of 6,300 bound and unbound volumes amounted to U.S. Dollars 21,184.15 for the entire fiscal year of 1940-1941).[3]

In a letter dated November 29, 1940, to Robert B. Downs, Chairman of the American Library Association Board of Resources, Colonel Jones stat-

2. On January 1879 the first issue of the *Index Medicus* appeared; and the first volume of the *Index-Catalogue of the Library of the Surgeon-General's Office*, in 1880; activities started under the direction of John Shaw Billing (Director 1865-1895).

3. The Annual Report in the Library's archives, by Leslie K. Falk, head of the Acquisition Department, 1940-1941.

Arabic Manuscripts of the National Library of Medicine, Washington, D.C.

SAMI HAMARNEH*

This study continues an effort commenced by me in 1964 to make better known the Arabic medico-pharmaceutical manuscript holdings of libraries in various parts of the world. Thus far three publications dealing with the collections at the national libraries of Damascus, Cairo, and London have appeared.[1]

It had been my hope to prepare a comprehensive, annotated and illustrated catalogue of all the Arabic manuscripts on medicine, pharmacy, alchemy, and allied sciences, housed in the National Library of Medicine in the Washington metropolitan area. To this end a systematic study has been made. It is now clear, however, that it will be impractical to complete the project in the foreseeable future. Pending the appearance of a definitive catalog by some other scholar, it seems useful to publish at this time the survey which follows.

After sketching the history of the collection, the succeeding sections are organized roughly in a chronological order. Their names indicate the author or category of the manuscripts described. A certain amount of background material has been included to round out the general picture of medico-pharmaceutical development in Islam.

Origins of the Collection

Established in 1836, the Library of the U.S. Army Surgeon General's Office, as it was then known, served the needs of the military medical corps and the immediately affiliated units. Later on, its mission and services expand-

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The author wishes to thank the staff of the National Library of Medicine, Division of the History of Medicine for their generous help in allowing him to consult the manuscript collection and other rare books, and in providing microfilm and photoprints needed for his research on this article. For all their kind cooperation he is most grateful.

1. *Index of Arabic Manuscripts on Medicine and Pharmacy at the National Library*, Cairo, al-Maḥāsin, 1967; *Index of Ar. Mss. in the Ẓāhiriyah Library*, Damascus, Arab Academy, 1968-69; and *Catalogue of Arabic Mss. on Medicine and Pharmacy at the British Library*, Cairo, 1975, published under the auspices of the Smithsonian Institution.

Despite Dioscorides' description of *Aqūnītun* (1) and (2) as being different types of the same plant, it is unlikely that either is in fact to be considered as an *Aconitum*. It would seem that Dioscorides' (1), the *Aqūnītun*, which he says has leaves similar to the cucumber's, and a root like a scorpion's tail, as Mr. Gorer points out, cannot be an Aconitum, but would indicate a *Doronicum*. This theory is supported both by the description and by the fact that this plant is found in Spain and Asia Minor.
(2), the *Lūquṭūnun*, with leaves like the plane and roots compared to shrimps' legs, could well be one of several *Delphinium* species, whereas it does not really apply to any *Aconitum*; maybe *Delphinium staphisagria* or *D. elatum*.

Antula's names of "coriander of the fox" and "acorn of the earth" suggest the ground-nut *Bunium*: *B. alpinum corydalinum*, *B. alpinum macuca* or *B. pachypodum*.

The most likely candidate, in Andalus, for *Aqūniṭun* is thus *Delphinium*; for *Antula*, *Bunium*.

There are in Andalusia three species of annual Delphinium whose leaves are similar to Aconite, and these could well be found growing near the *Bunium* species. *Aconitum anthora* is found in northern Spain; since herbalists obtained their drugs from a wide area, one cannot be absolutely sure to what range of plants they had access, particularly if they were accustomed to using dried products.

Judging from botanical writings, however, it would seem that once a plant in any particular area was given a name this would be retained. Botanists and pharmacists would after long acquaintance with a drug be able to refer with confidence to the texts, regardless of whether the Greek name in itself was a precise equivalent to the Arabic. It was in the end from their experience rather than their reading that the Arabic physicians were able to prescribe and rely upon the old and new plants from their extensive materia medica.*

* My thanks are due to the Bodleian Library, Oxford, for access to books and manuscripts and in particular MS Hyde 34 from which the Arabic text here printed is taken; to the Oriental Institute and the Taylorian Institute, Oxford; the Biblioteca Nacional, Madrid. For help with identifications for the plant names I am grateful to Mr John H. Harvey of Frome, Somerset, and Mr Richard Gorer of Petham, Canterbury, England.

فانه ينفعهم مع الرماد مع الشراب ايضاً نافع لهم جداً ومرق الدجاج او لحم الغنم أولحم البقر السمينة مع الشراب نافع لهم جداً ويقال ان الكمافيطوس خاصة لهم جيد ينفعهم .

(='On Poisons', Book VI Ch. 7; Kuhn Vol. II. p. 22)

Although a plant can thus be traced in the medical texts, its actual identification is a far more complex matter. The Arabic botanists themselves often tried for a one-to-one equivalent with the Greek name, while realising that there were both linguistic and botanical variations to be taken into account. Names of medicinal and other plants were taken from east to west with the expansion of the Islamic empire and the spread of medical and scientific texts.

The fact that a Greek plant is given an apparently precise Arabic equivalent does not, however, imply identity. Dioscorides himself came from Anazarba in Cilicia, Asia Minor, while he incorporated earlier Greek writings into his herbal which was then used widely within Greece and beyond. Its subsequent translation into Arabic made it necessary to seek names for plants found in the eastern empire; when the herbal arrived in Andalus, in the western end of the Mediterranean, the possibilities for variation were increased even further.

Perhaps the most one can hope for today is to give approximate identifications rather than attempt to be too precise. The table which follows is a simple parallel list of the botanical terms as found in the Greek and Arabic versions of these two short articles on *Akoniton-Aqūniṭun*.

ARABIC	GREEK	POSSIBLE IDENTIFICATION
اوريغانن	origanon	Origanum sp. (majorana?)
سذاب	peganon	Ruta graveolens
اوفراسيون	prasion	Marrubium (vulgare?)
افسنتين	apsinthion	Artemisia absinthium
جرجير	euzomon	Eruca sativa
قيصوم / شيح ارمني	abrotonon	Artemisia abrotanum
خامالاما	khamelaia	Daphne cnidium (west) D. oleoides (east)
كمافيطوس	khamaipitus	Teucrium chamaedrys
بلسان	opobalsamon	Commiphora opobalsamum
فلفل	peperi	Piper nigrum
لوقوقطونن	lukoktonon	* Aconitum (vulparia?) east Delphinium sp. (west)
دلب	platanos	Platanus orientalis
بطارس	pteris	Pteris aquilinum
مووطونن	muoktonon	* Aconitum napellus (east) Delphinium sp. (west)
قفلامينس	kuklaminos	Cyclamen sp. (Persicum?) (east)
قثا	sikuos	Cucumis sativus**

* see notes which follow.

** For these notes and suggested identifications I am indebted to Mr. Richard Gorer, of Petham, Canterbury, who kindly commented in some detail on the lists in the light of his special knowledge of plants in the relevant areas.

or absinthium or rocket or abrotanum (which is the Armenian artemisia) or chamelaia or teucrium: whichever of these you administer, let it be drunk with wine. Beneficial also to such can be oil of balsam if one takes a drachm's weight of it in wine, or a drachm's weight with an ounce of milk, castoreum, pepper and rue, a drachm in wine; or the rennet of a kid or of a hare or of a young deer, when drunk with vinegar, is beneficial. Also, one can heat scoria of iron, or iron itself, or gold or silver, then quench it; whichever one has, this is put in wine and drunk. It is of benefit with ashes with wine also, and this is very useful; gravy of chicken, or meat of sheep or fat cattle, with wine, is also very useful to them.

It is said that teucrium is of special benefit in such cases.

Ms. Hyde 34, f. 123a, line 4 f.

اقونيطن*١

ومن الناس من يسميه البنحاس ومنهم من يسميه*٢ موومأوين وهو نبات له ثلاث ورقات عدداً أو أربع شبيهة بورق النبات الذي يقال له فقلاميس أو ورق القثاء الا انه أصغر منه وفيها خشونة ولها ساق طولها نحو من شبر وأصل شبيه بذنب العقرب يلمع مثل القوارير. وقد يزعم بعض الناس ان أصل هذا النبات اذا قرب من العقرب أجمدها وانه اذا قرب الخربق اليها بعد ذلك أنعشها*٣ وقد يقع في أدوية العين المسكنة لأوجاعها واذا صير في اللحم وأطعمته النمور والخنازير والذئاب والفأر وسائر السباع قتلها .

(Dioscorides: IV. 76 (W), 77 (K)

Ms. Hyde 34, f. 123a, line 11 f.

وقد يكون صنف آخر من الأقونيطن ومن الناس من يسميه لوققطونن وقد ينبت كثيراً بالبلاد التي يقال لها ايطاليا في الجبال التي يقال لها اونسطينا وله ورق شبيه بورق الدلب الا انه اشد (...) وأصغر بكثير واشد سواداً وله ساق شبيه بساق النبات الذي يقال له بطارس وأغصان جرد طولها نحو من ذراع أو أكثر قليلا وثمر في غلف ذات طول يسير وعروق شبيهة بأرجل الاربيان سود ويستعمل في قتل الذئاب فانه اذا استعمل في لحم ني وأكلته الذئاب قتلها .

(Dioscorides: IV. 77 (W), 78 (K)

MS. Hyde 34, f. 187a, line 14 f.

اقونيطن

الذين يسقون هذا الدواء يعرض لهم على المكان في حس المذاق حلاوة مع شيء من قبض ثم من بعد ذلك يعرض لهم ثلال وظلمة في البصر ورطوبة في أعينهم وثقل في صدورهم وفيما دون الشراسيف مع خروج رياح كثيرة من أسفل وينبغي اولا ان يحتال في اخراج الدواء المسموم بالقيء والحقن وان تقدم في سقيهم هذه الاشياء التي نذكرها وهي اوريغانس أو سذاب مع شراب أو فراسيون أو أفسنتين أو جرجير أو قيصوم وهو الشيح الارمني أو حامالايا أو كافيطوس وأي شيء سقى من هذه فليسق بشراب وقد يوافقهم أيضاً دهن البلسان ان اخذ منه مقدار درحمى بشراب أو اخذ منه مقدار درحمى مع أوقية لبن وجندبادستر وفلفل وسذاب درحمى بشراب أو انفحة الجدى او انفحة الارنب او انفحة خشف الايل اذا شرب بالخل نفعتهم وخبث الحديد يحمى او الحديد بعينه او الذهب او الفضة ويطفأ أيها كان في شراب ويشرب الشراب

١* يشبه اليبروح وهو النبال هو خانق النمر وغيره من الحيوان

٢* قورون ومن الناس من يسميه ساسرودوين ومنهم من يسميه قوبوطون

٣* S. p.

is probably the same man responsible for a commentary on Ibn Juljul's supplement, made in Marrakush in the 12th century A.D.[12]

This account of 'Aconite', taken from the manuscript Hyde 34 in the Bodleian Library, Oxford, is omitted from Dubler's edition and has not been previously printed; it is a close translation of the Greek version, and thus illustrates the correspondence of Greek with Arabic plant names.

DIOSCORIDES - Translation

Aqunitun - Akoniton

(1) Hyde 34, f. 123a, 1.4 (Kühn, IV.77; W. IV. 76)

*AQŪNIṬUN:**

Which some call al-Pinḥās (?), others** mūṭūnun: this is a plant with three or four leaves, similar to those of the plant called (qiqlāmīnus) or those of the cucumis, yet smaller and somewhat rough. It has a stalk about a span in length, and a root resembling a scorpion's tail, shining like glass. Some claim that when the root of this plant is placed close to a scorpion, it paralyses it, and that when helleborus is placed near it after that it revives it. It can occur in eye medicaments, as an anodyne. When it is put into meat and fed to leopards, swine, wolves, rats and other beasts, it kills them.

(2) f. 123a, 1. 11

There is found another species of aqunitun, which some call luqutunun, which is plentiful in the land called Italia, in the mountains known as Awnestina (i. e. Ouestinos = Vestina, in Italy). It has a leaf similar to the plane tree, save that it is more dissected and much smaller, and blacker.[13] It has a stalk like that of the plant called bitaris (fern: pteris) and bare shoots, of about a span in length. It has fruit in longish capsules, and roots like shrimps' legs, black. It is used for killing wolves, and if it is put into raw meat and the wolves eat this, it kills them.

(3) Hyde 34, f. 187a, 1. 14

From maqāla 6, on poisons

(Kühn, p. 22, Ch. 7 of book VI)

Aqūniṭun:

Those who drink this drug are immediately aware of a sweet taste with some astringency. Next they are afflicted by trembling (Gk: vertigo) and darkness of sight and moisture in the eyes, heaviness in the chest and the abdomen (epigastrium) together with the expulsion of wind below. The first treatment must be to expel the poisonous drug by emesis and a clyster, and one starts by administering the following items: origanum or rue with wine, or prasion

12. Nuruosmaniye MS 3589, Istanbul, f. 80b-129b.

* : Resembles mandragora; it is nabbāl, and killer of the leopard and other animals.

** : Qūrūn, and some call it ? bābirūdūyun, and some qūnūṭūnun (marginal notes).

13. The Arabic word after *ashaddu* is not clear, but must be meant to correspond to the Greek *apeschismena*, (more) deeply split or incised.

as a poisonous drug, for which the antidote is *Bustān abrūz*; this he gives on the authority of Yaḥyā b. Sarābīyūn. This plant is *Amaranthus tricolor L.*

The extract from Ibn Juljul's Supplement is quoted by al-Ghāfiqī, with slight variations, but giving *Bustān abrūz* as antidote for *Nabāl*. (No. 156).

It is quoted again by Ibn al-Bayṭār (I. 94) including the names *Aqūniṭun* and *khāniq al-numr*.

BĪSH[8]

This can be a synonym for *Aqūniṭun*; and in the 'addition' to the Supplement of Ibn Juljul (Hyde 34, f. 201a) it is named as the poisonous plant for which a remedy is *Antula*.

Bīsh (or *Baysh*) occurs in a tale of 'political' poisoning in Andalus; ᶜAbd al-Wāḥid al-Marrākushī (d. 1185 AD) in his account of the governorship of al-Mustakfī tells of how this ruler went to the frontier region with one of his commanders, who poisoned him with a chicken oiled with *Baysh*.[9]

Cattle who might eat this plant were more fortunate, for they could have access to its antidote:

ANTULA

This is spoken of as an antidote for *Nabāl* or *Bīsh*. The name does not occur in the Dioscorides versions, but in an 'addition' to Hyde 34 – presumably notes made by a local botanist – it is stated that 'in Andalus occurs the *Antula* which is beneficial for hot pains and deadly poisons... it often grows with the *Bīsh*, and when flocks graze on *Bīsh* because of its sweet taste, and this overcomes them, they eat the *Antula* which is bitter and they are saved.. This *Antula* is an effective antidote: when it is lacking, its substitute is *Janṭiyānā*, but *Antula* is superior as anodyne and antidote'.[10]

Maimonides under *Jidwār* (No. 81) says that one species is called *Antula*.[11]

Ibn al-Bayṭār, quoting from earlier authorities, describes the black and white: the former being called also *al-Jidwār al-andalusī* (thus confirming Maimonides' remark). (I. 66) In *ᶜajamīyat al-Andalus*, this is the plant resembling the one called in the Maghrib 'better than 1000 dinars' خير من الف دينار it is 'coriander of the fox' كزبرة الثعلب. Isḥāq b. ᶜImrān called it 'acorn of the earth' بلوط الارض

Then Ibn al-Bayṭār quotes from Ibn al-Kattānī, a 12th-century AD herbalist from Marrakush, relating on the authority of a 'reliable person' that in the marshes of Saraqusta there are two plants which seem to be growing from one root: one called *Ṭuwāra* is a deadly poison, while the other, *al-Antula*, is a wonderful drug, 'taking the place of the *tiryāq*'; he has tested this. He said that flocks eat the poisonous plant because of its sweetness, and then eat the other plant and are saved from the poison. The writer quoted here

8. *Bīsh* as used here is to be distinguished from the Indian plant of this name – see M. Meyerhof, "The Article on Aconite from al-Bīrūnī's Kitāb al-Saydana", *Islamic Culture*, 19(4) 1945.

9. al-Marrakushi's history edited by R. Dozy as *The History of the Almohades*, Amsterdam 1968, p. 40.

10 Hyde 34, f. 201a

11. Maimonides, *Sharḥ asmāʾ al-ᶜuqqār*, ed. M. Meyerhof, Cairo 1940, No. 81.

to equate names in the two languages; "synonyms"may refer to different species.

Ibn Juljul later wrote a *Tafsīr* or explanation of Dioscorides, giving for each name its Arabic equivalent, its name, if any, in other languages, and in the local tongue which he calls *laṭīnī*, an early form of Spanish. This work exists in part in Madrid: 315 items from books 3, 4 and 5 of Dioscorides' herbal are listed with their synonyms[5]. This work of Ibn Juljul was later used by al-Ghāfiqī (d. 1166 AD) and again by Ibn al-Bayṭār (d. 1248 AD).[6]

The Arabic translation of Dioscorides, in the version made by Iṣṭifan b. Bāṣīl and revised by Ḥunayn, was published by C. Dubler and E. Teres 1952-57. The editors were restricted in their choice of manuscripts, and some items which form part of the Herbal do not appear in their edition.[7]

One such plant is the *Akoniton* of Dioscorides, which was of considerable interest to the Arabs and went under several names. Dubler and Teres refer (p. CXLII) to the fact that Dioscorides IV. 76-80 are missing from the Arabic, and they do not refer to any extra item in the Paris manuscript. On their p. 340, after *Mandragora*, the next plant is *Nerion*.

Following on from *Mandragora*, however, in the MS Hyde 34 (Bodleian Library, Oxford) f. 123a, is the article on *Akoniton* corresponding to Dioscorides IV. 76 (W), 77 (K). In Hyde 34 it is transcribed as اقونيطن and two species are described. Hyde 34 also has marginal notes, some of which relate directly to the *Tafsīr*.

Alternative names for *Aqūnīṭun* are given as البنحاسى and مروطون presumably approximating to the Greek *apokunon* and *muoktonon*. The Greek text gives other alternative names. For the second variety, Hyde 34 gives لوقتطون (f. 123a); i.e. the Greek *lukoktonon*, wolf killer.

The marginal note on f. 123a gives other names as *nabbāl*, *khāniq al-numr wa-ghayrihi min al-ḥayawān* (strangler, killer, of the leopard and other animals); qūrūn, and? bābirūdūyun, and qūnūṭūnun; the first and third of these are probably the kammaron and kunoktonon (dog killer) of the Greek text. The last name is in a separate note.

Ibn Juljul in his *Tafsīr* (f.7a) deals with the *Akoniton*, transcribed as اقونيطن. He explains it as *qātil al-numr wa-l-ins*, killer of the leopard and the human; known 'among us' as *nabāl*, and grows in the region of Elvira.

The second entry in Hyde 34, f. 187a, in *maqāla* 6, corresponds to the spurious Book VI on Poisons (Vol. II, p. 22 in Kühn) and gives the treatment for those who have unwittingly taken *Akoniton*.

NABĀL (or *NABBĀL*) - *Akoniton*

The name *Nabāl*, given by the marginal note of Hyde 34 and in the *Tafsīr* as being equal to *Aqūnīṭun*, also occurs elsewhere. First, we find it in Ibn Juljul's Supplement to Dioscorides (Hyde 34, f. 198b) where it is mentioned

5. Madrid 4981.

6. (a) *The Abridged version of 'The Book of Simple Drugs' of Aḥmad ibn Muḥammad al-Ghāfiqī by Gregorius Abūl-Faraj (Barhebraeus)*, ed. M. Meyerhof and G.P. Sobhy, Cairo, 1932-40; (b) ʿAbdallāh b. Aḥmad Ibn al-Bayṭār, *al-Jāmiʿ li-mufradāt al-adwīya waʾl-aghdhīya*, Cairo, 1874.

7. C. E. Dubler and E. Terés, eds. *La version arabe de la 'Materia Médica' de Dioscorides* (texto, variantes e indices), Tetuan and Barcelona, 1952.

Aconite and its Antidote in Arabic Writings

PENELOPE JOHNSTONE*

Materia medica is a branch of medicine in which the Arabic contribution is particularly valuable. Translations of Greek herbals were the basis for much practical study and observation, and the Arabic writers produced a rich literature of medico-botanical work, later passed on to the medieval Latin west.[1]

The "Aconite" has been chosen to illustrate a cross-section of such writings. Though not strictly medicinal, being a highly poisonous plant, the *Aconitum napellus* is frequently mentioned in medical literature, thus providing an example of some of the chief concerns and interests of the writers.

Plants and plant products formed a large proportion of Arabic materia medica and thus of therapeutic resources, and find a prominent place in medical texts. Since medicine was considered equally as 'preservation' and 'restoration' of health, diet, plants and fruits were important.

Poisonous plants featured too, since it was vital to recognise them and to know the appropriate remedies. A whole literature grew up around the *tiryaq*, a descendant of the Greek *theriak*.[2]

The Arabs' botanical medicine demonstrates very clearly their use not only of Greek writings but also of local resources. Dioscorides' herbal (1st century AD) was supplemented by their own researches and by new plants and drugs.[3] In particular this applies to Spain, a region rich in medicinal plants.

The Arabic writers in Andalus, Muslim Spain, had a full accurate translation of Disocorides' herbal by the mid-10th century AD. The earlier version made in Baghdad had left a number of names untranslated, for Ḥunayn b. Isḥāq, despite his skill and meticulous care, was not likely to have access to specimens or precise details of all plants whose natural habitat was Greece, and he recognised this fact, leaving names to be completed by later scholars.

The revised translation made in Cordoba filled in the gaps and left only a few of the names unaccounted for in Arabic, as we are informed by Ibn Juljul of Qurṭuba, a practical botanist who himself was concerned in the work.[4] A translation of this kind involved the problem, recognised by the Arabic workers, that species varied from one region to another. This made it hard

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1. On Arabic medicine see: M. Ullmann, *Die Medizin im Islam*, Leiden/Cologne 1970; E.G. Browne *Arabian Medicine*, Cambridge 1962 (reprint of 1921 edn.); M. Meyerhof, "Esquisse d'histoire de la pharmacologie et botanique chez les Musulmans d'Espagne",*al-Andalus*,1935, 3, 1-41; Ibn Abī Uṣaybiʿa, *ʿUyūn al-anbāʾ fī ṭabaqāt al-aṭibbāʾ*, Cairo 1882 and Beirut 1965.

2. C. Singer, "The Greek Herbal in Antiquity", *J. Hellen. Studies* 1927; B. Fares, *Le Livre de la Thériaque*, Cairo 1953; M. Levey, *Early Arabic Pharmacology*, Leiden 1973, p. 131-145.

3. Dioscorides: *Pedanii Dioscoridis Anazarbei, De Materia Medica Libri quinque*, (K): ed. D.C.G. Kuhn, Leipzig, 1829; (W): ed. M. Wellmann, Berlin 1907.

4. Ibn Juljul's account is reported by Ibn Abī Uṣaybiʿa, *op. cit.*, (Cairo edn.) II, 47-48.

Arabic – English Glossary

Paint صباغ
Plate صفيحة
Sheet صفيحة
Circular plate صفيحة مستديرة
Grindstones الصلايا
Version ضرب
Cross rungs عارضات
Pillar عمود
Stanchion عمود ، ركن
Cross-section (size) غلظ
Size of the cylinder غلظ الاسطوانة
Pool غمرة ، بركة
Small-span فتر
Vanes فرجات
Support قاعدة ، ركن
Disc قرص
Rod قضيب
Scoop كفة
Scoop of the ladle كفة المغرفة
Jar كوز
Axle محور
Vertical axle محور منتصب
Activator of the machine مدير الآلة
Drive (driver) مدير الآلة
Machine driver مدير الآلة
Flat surface مستوى الوجه
At right angles معارض
Transverse معارض
Ladle مغرفة
Straigh\ened مقوّم
Perpendicular منتصب
Vertical منتصب
Fixed موثق به
Slanted مورب
Channel ميزاب
Hinge نرماذجه
Category نوع
Dowel (crank pin) وتد
Tightly يدخل قهرا
Directly above the centres of or opposite يسامت

Millstones الارحاء
Column اسطوانة
Pedestal bearing : اسكرجة (سكرجة)
Spans اشبار
Machine آلـة
Narrow pipe أنبوب دقيق
Wide pipe انبوب غليظ
Pipe بربخ
Bearing بيت
Paddle جناح
Ring حلقة
Recess خرق
Slot خرق
Mulberry wood خشب التوت
Disengage خلص
Dirham درهم
Teeth دندانجات
Tooth دندانجة
Revolution دورة
Wheel دولاب
Cog wheel دولاب ذو دندانجات
Toothed wheel دولاب ذو دندانجات
Vaned wheel دولاب ذو فرجات
Sindi wheel دولاب سندي
Scoop wheel دولاب الـكفات
Cubit ذراع
Stem ذنب المغرفة
Strap رباط
Quarter wheel ربع دولاب
Clack-valve (non return valve) ردادة
Staple رزة
Raṭl رطل
Strong stanchions ركنان ثابتان
Ejector of naphtha زراقة نفط
Irrigation channel ساقية
Pedestal bearing سكرجة (أسكرجة)
Arm سهم
Lever-arm سهم
Span شبر
Barley-corn (thickness) شعيرة

English — Arabic Glossary

English	Arabic
Activator of a device	مدير آلة
Arm	سهم
Axle	محور
Barley-corn (thickness)	شعيرة
Bearing	بيت
Bearing (pedestal)	أسكرجه او سكرجة
Category	نوع
Channel	ميزاب
Circular plate	صفيحة مستديرة
Clack-valve (non-return valve)	ردادة
Cog wheel	دولاب ذو دندانجات
Column	اسطوانة
Cross rungs	عارضات
Cross-section, (size)	غِلَظ
Cubit	ذراع
Dirham	درهم
Disc	قرص
Disengage	خلص
Dowel, (crank pin)	وتد
Drive (Driver)	مدير الآلة
Ejector of naphtha	زراقة النفط
Fixed	موثق به
Grindstone	الصلايا
Hinge	نرماذجة
Irrigation channel	ساقية
Jar	كوز
Ladle	مغرفة
Lever-arm	سهم
Machine	آلة
Machine driver	مدير الآلة
Millstones	الأرحاء
Mulberry wood	خشب التوت
Narrow pipe	انبوب دقيق
Paddle (paddles)	جناح (أجنحة)
Paint	صباغ
Pedestal bearing	اسكرجه أو سكرجه
Perpendicular	منتصب
Pillar	عمود
Pipe, cylinder	بربخ ، انبوب
Flat surface	مستوي الوجه
Plate	صفيحة
Pool	غمرة ، بركة
Quarter-wheel	ربع دولاب
Raṭl	رطل
Recess	خرق
Revolution	دورة
Rod	قضيب
Ring	حلقة
Scoop	كفه
Scoop of the ladle	كفة المغرفة
Scoop wheel	دولاب الـكفات
Sheet	صفيحة
Sindi wheel	دولاب سندي
Size of the cylinder	غِلَظ الاسطوانة
Slanted	مورب
Slot	خرق
Small-span	فتر
Span	شبر
Stanchion	عمود ، ركن
Staple	رزة
Straightened	مقوم
Strap	رباط
Strong stanchions	ركن ثابت
Support	قاعدة ، ركن
Teeth	دندانجات
Tightly	يدخل (قهراً)
Tooth	دندانجة
Toothed wheel	دولاب ذو دندانجات
Transverse	معارض
Vaned wheel	دولاب ذو فرجات
Vanes	فرجات
Version	ضرب
Vertical	منتصب
Vertical axle	محور منتصب
Wheel	دولاب
Wide pipe	انبوب غليظ

10. *Bodleian Library, Oxford*

Frazer 186.

This is a rather good copy. It is a late one, being dated 1084 H (=1673).

11. *Bibliothèque Nationale, Paris*

Fonds Arabe 5101.

This is an eighteenth-century copy without illustrations.

12. *Chester Beatty Library, Dublin*

No. 4187.

This copy is incomplete, with many pages missing, and all folios are stained and damaged at the edges. No chapter is absolutely complete. Some drawings are very good and follow the text faithfully. Other drawings are poor. The date is uncertain.

13. *Bibliothèque Nationale-Paris*

Suppl. Pers. 1145 and 1145 a.

This is a late Persian translation. It is dated 1291/1874.

14. *Dispersed Istanbul manuscript*, (715 H)

This manuscript is completely dispersed. It has been described by M. Aga-Oglu[15] and others. It is dated 715/1315. Many of its plates are now in the West and several of them were reproduced in Hill's book. The plates are of very good quality comparable to that of the first three manuscripts.

15. op. cit (see Hill, footnote 1).

This is one of the earlier copies. It is dated 863/1459. King[14] recommended it for study, but the illustrations were found to be of inferior quality from a technical point of view. Hence it was not adopted for editing the Arabic text.

5. *Bibliothèque Nationale, Paris*

Fonds Arabe 2477.

This is dated 890/1485. It is incomplete, comprising only the second part of the manuscript, and without illustrations for the chapter on water- lifting machines.

6. *Bodleian Library, Oxford*

Graves 27.

This was the only manuscript that was translated and studied from a technical point of view by Wiedemann and Hauser, and recently by Hill. It is dated 891/1486. It is a good copy, but it is not comparable to the first three manuscripts.

7. *Library of the University of Leiden*

Or. 656.

This is a poor and an incomplete copy with many drawings missing. It is dated 969/1561, and was copied from the Bodleian manuscript (Graves 27).

8. *Library of the University of Leiden*

Or. 117.

This is also an incomplete and a poor copy. The text is very difficult to read and the drawings are very bad (See Hill).

9. *Topkapi Sarayi Muzesi Kutuphanesi, Istanbul*

Topkapi, Ahmet III, 3461.

This is a good but rather incomplete copy. Some pages are not original and are written badly, with very poor illustrations; but the major part is of good quality. This manuscript was probably written at the same period as the first three manuscripts.

14. op. cit., King (see footnote 5).

Al-Jazarī's Manuscripts
Brief Information

1. *Topkapi Sarayi Muzesi Kutuphanesi, Istanbul*

Topkapi, Ahmet III, 3472.

This manuscript is known to be the oldest existing copy. It is possibly dated 602/1206. It is the main manuscript that is being used in editing the present Arabic text. It is a rather complete and very good copy, and is one of the three best existing manuscripts. It was not available till recently.

2. *Topkapi Sarayi Muzesi Kutuphanesi, Istanbul*

Topkapi, Hazine, H 414.

This is the second oldest existing copy. It is dated 672/1274. It is a rather complete and a very good copy, and one of the three best existing manuscripts. This was not known to exist till recently.

3. *Suleymaniye U. Kutuphanesi, Istanbul*

Hagia Sophia 3606.

This is the third oldest existing copy, and it dates back to 755 / 1354.

It is the most famous to historians of Islamic art. This was due to the detached plates which were distributed in the West. Much literature was written on "Automata Miniatures".

The main plates of al-Jazarī are fifty, corresponding to the fifty devices described in his treatise. Every plate is numbered in the Arabic alphabet from 1 (آ) to 50 (ن). According to Riefstahl, [13] 23 plates were missing, out of which 15 were located, and 8 were not yet traced. Upon examining the microfilm used in this manuscript the findings of Riefstahl were confirmed, but other illustrations were found to be missing also.

This copy is a very good one also, and it is one of the three main copies that were used in editing the Arabic text.

4. *Topkapi Sarayi Muzesi Kutuphanesi, Istanbul*

Topkapi, Ahmet III, 3350.

13. Holter, Kurt, "Die islamischen Miniaturhandschriften vor 1350", *Zentralblatt für Bibliothekswesen* 54 (1937) 5-8. See also:

Buchthal, H., Kurz, O., and Ettinghausen, R., "Supplementary notes to K. Holter's check list of Islamic illuminated manuscripts before A. D. 1350" *Ars Islamica*, 7 (1940) 148-149.

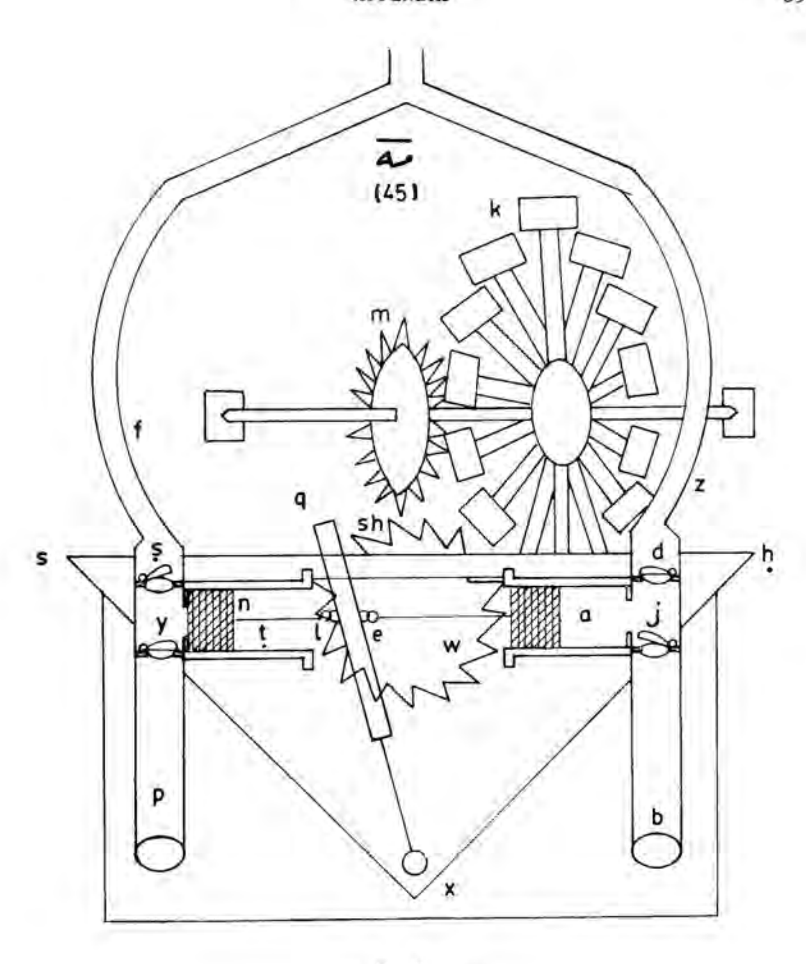


Fig. 8
(based on MS. 3472)

The above remarks regarding the position of the driving disc, the oscillating slotted rod, and the box, were confirmed by the publication of Taqī-al-Dīn's Manuscript on Spiritual Machines.[12] Taqī-al-Dīn, described a pump similar to that of al-Jazarī and in this pump these driving elements were also horizontal.

Before concluding these notes, Figs. 7a and 7b which give the details of the pumping elements, have also been reproduced.

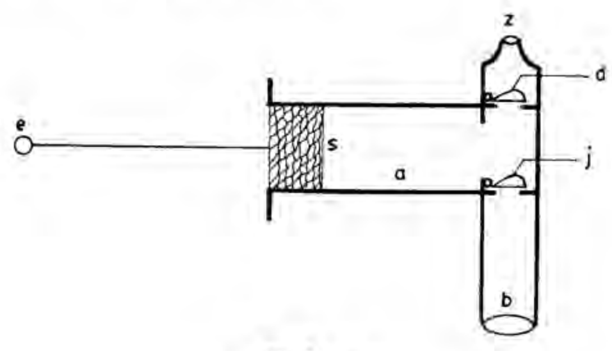


Fig. 7 a
(based on MS. 3472)

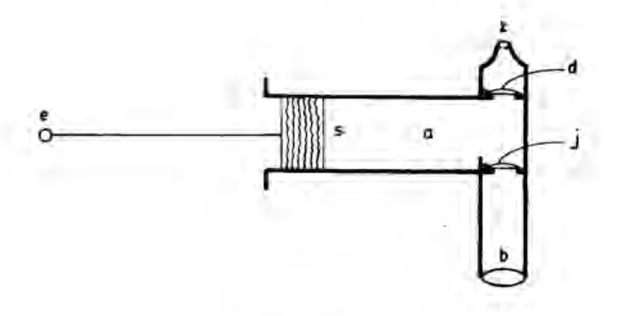


Fig. 7 b
(based on MS. 3606)

12. Al-Hassan, Ahmad Y., *Taqī-al-Dīn and Arabic Mechanical Engineering*, with a facsimile copy of "The Sublime Methods of Spiritual Machines." (الطرق السنية في الآلات الروحانية) Aleppo IHAS, Aleppo University, 1976.

guity which was caused by the wrong orientation of the illustration in the Bodleian manuscript.

The translation of the text is as follows:

"The second version: a wheel with paddles is fitted to the end of a horizontal axle, some of its paddles immersed in running water. On the other end [i.e. of the axle] is a toothed-wheel which turns, with its rotation, a disc having teeth on its perimeter, and which has on its side a *vertical* dowel which operates the machine. I have shown a picture of that [Fig. 6]; the paddle wheels, the toothed-wheel *x*, *which turns a disc on the upper end of an axle* (على أعلى محور), *the lower end of which is in a pedestal bearing* (اسكرجة). *Below its upper end* (ودون طرفه الاعلى) *is a ring in which the axle rotates*, and on its extreme end is the disc *l*, and on the side of the disc is a *vertical* dowel z, which operates the machine".

Some words were printed in italics to point out that, in this version also, as in the first version of drive, the activating or driving disc *l* in Fig. 6 (which has a vertical dowel) is carried on the top of a vertical shaft, and that this disc is horizontal. This also means that the pivoted oscillating slotted lever arm should lie in a horizontal plane.

Now we will consider Fig. 8 which is a reproduction of the whole machine. This figure is based on plate 45 (مه) in the manuscript. The above concept of a horizontal driving disc is obvious from this figure. Although al-Jazarī is obliged to show all major details in one illustration, he was still able to explain by the way he drew the two toothed-wheels that they were not in one plane.

From the above remarks and from the text that follows we conclude that the triangular box is horizontal and not vertical. This means that the two flat triangular faces of the box lie in a horizontal position.

The text states:

"As for the machine: a triangular box is made, its side about 8 sp. long and its *height* (وعلوه) 2 sp."

Then it states:

"Below its upper [face] a disc is installed at the end of an axle, *the other end of which is in the floor of the box and is rotating in a pedestal bearing. Underneath the disc is a ring in which the axle rotates.* On the circumference are teeth which project from the box. The disc inside the box is marked *w*, and the teeth which emerge *from the side* of the box are marked *sh*. On the face of the disc and at its side is a vertical dowel.

« ثم يتخذ دون أعلاه قرص على طرف محور، والطرف الآخر من المحور في أرض الصندوق ويدور على اسكرجة . وتحت القرص حلقة يدور فيها المحور وعلى دائر القرص دندنجات بارزات عن الصندوق . وعلى القرص من داخل الصندوق و وعلى الدندنجات وهي خارجة عن جانب الصندوق ش وعلى وجه القرص وتد منتصب عند حرفه » .

[وليكن الوتد ملبساً بصفيحة من حديد ، وداخل خرق نَ ملبس بصفيحة من حديد]

Device 5 of Category V

This is the most important machine in this category. It has been discussed or described by several authors.[11] Burstall gave an incorrect description of this machine, which was then cited by Needham. The interpretations of Wiedemann and Hauser and of Hill are correct, with only a few minor errors. Due to the importance of this pump which can be considered as "a more direct ancestor of the steam engine", it is significant to give here the main points which have been revealed in the edited Arabic text.

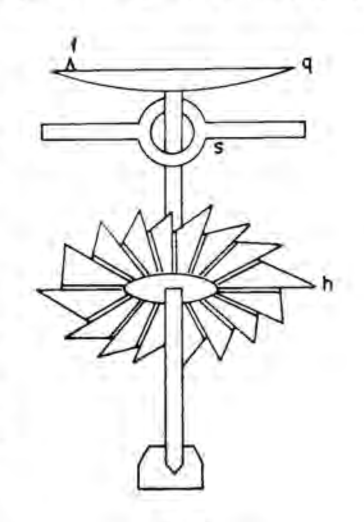


Fig. 5
(based on MS. 3472)

Fig. 5 is a reproduction of the first version of drive suggested by al-Jazarī. This is an immersed horizontal waterwheel similar to that of a Norse watermill. The vertical shaft of the waterwheel carries on its upper end a flat horizontal disc with an eccentric vertical peg on its surface. The disc with the eccentric peg, directly drives the pivoted oscillating slotted lever arm which actuates the two piston rods. *This can happen only if the oscillating slotted lever arm lies in a horizontal position.*

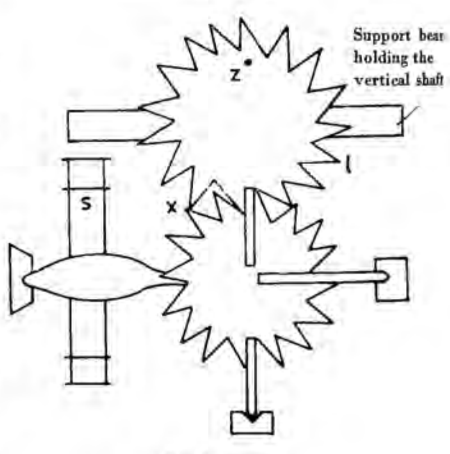


Fig. 6
(based on MS. 3472)

Fig. 6 is a reproduction of the second version of drive suggested by al-Jazarī. This corresponds to Fig. 139 in Hill's text. Fig. 6 solves the ambi-

11. Needham, Joseph, in collaboration with Wang Ling, *Science and Civilization in China*, vol. 4, Part II, Mechanical Engineering, Cambridge, 1965.

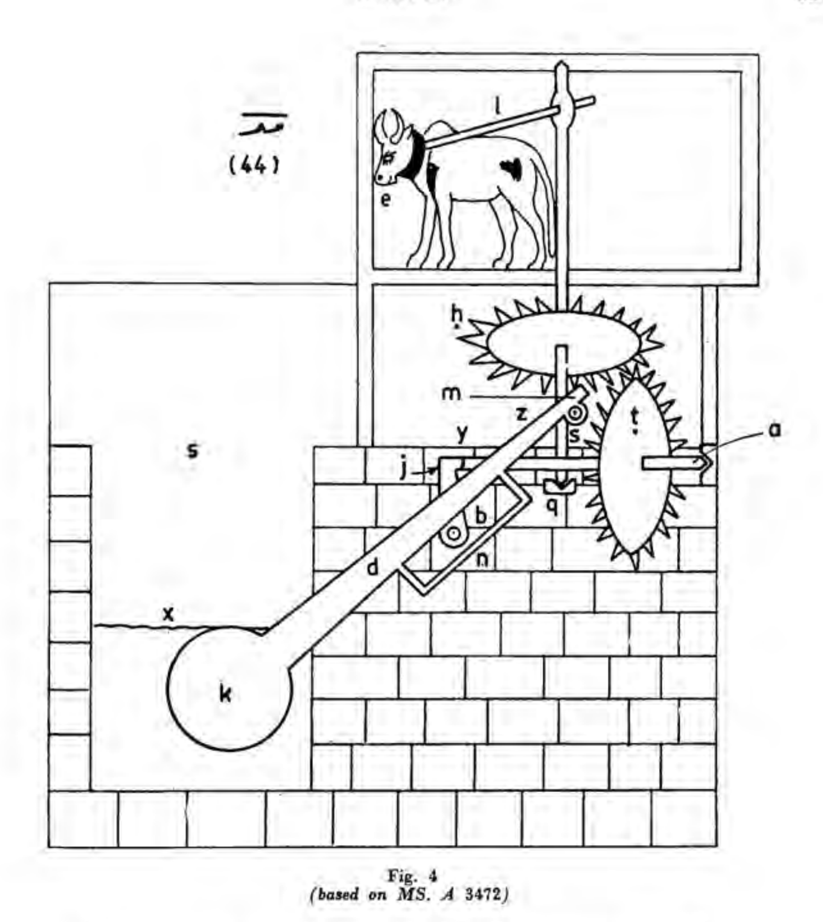


Fig. 4
(based on MS. A 3472)

The importance of this machine makes it necessary to define the two major points, which are made clear in the edited Arabic text:

1. al-Jazarī states that axle $a\ y$ is drawn projected on the plane of the paper in full length:

[... وعلى طرفي محوره ، وهو مبطوح ، أي ...]

2. He also states that the crankpin (or dowel) is sheathed in an iron sheet, and that the internal surface of the slot (n) is also sheathed in an iron sheet. Thus the Arabic text reads :

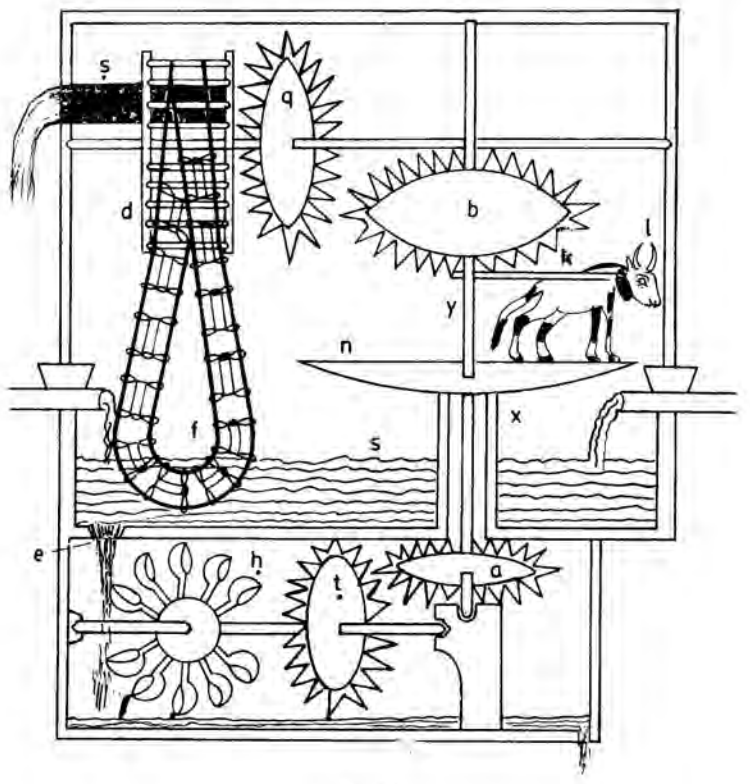


Fig. 3 b
(based on MS. A 3606)

Device 4 of *Category V*

Fig. (4) is based on plate 44 (مد) of MS. A 3472. This illustration is quite correct and corresponds to the text. The illustration which appears in MS. H 414 is equally good (if not better), whereas that of MS. A 3606 is less accurate. They correspond to Fig. 137 in Hill's book. This Fig. of the Bodleian manuscript has some obvious mistakes.

Device 3 of Category V

Fig. (3 a) is based on plate 43 (مج) in MS. A 3472, and Fig. (3 b) is based on MS. A 3606. This last figure has been redrawn just to show the details of the runged-wheel (*d*). They both correspond to Fig. 136 in Hill's English text.

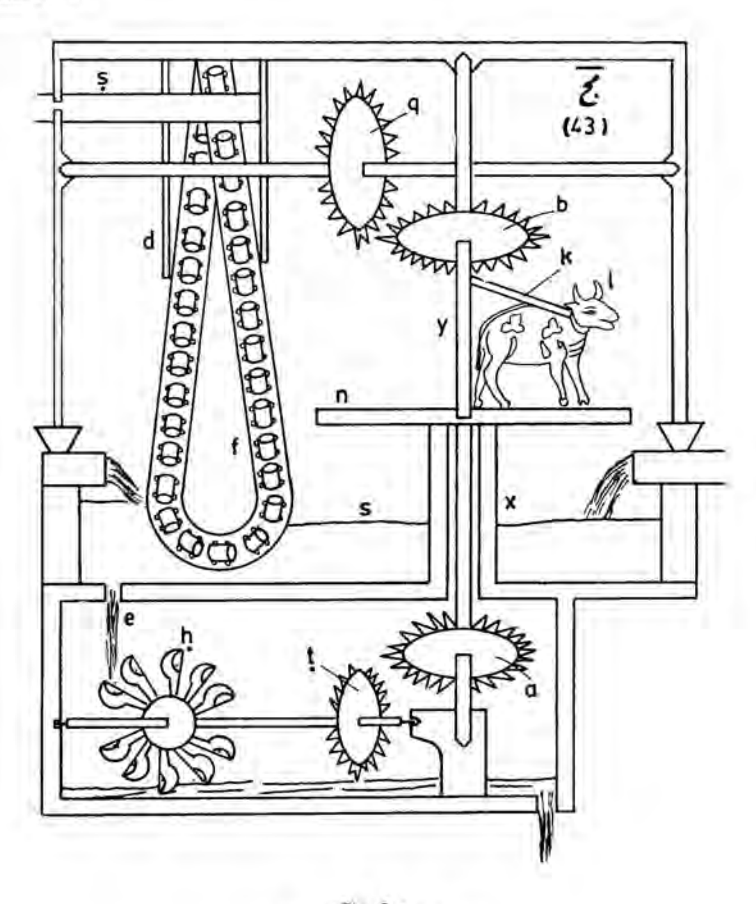


Fig. 3 a
(based on MS. A 3472)

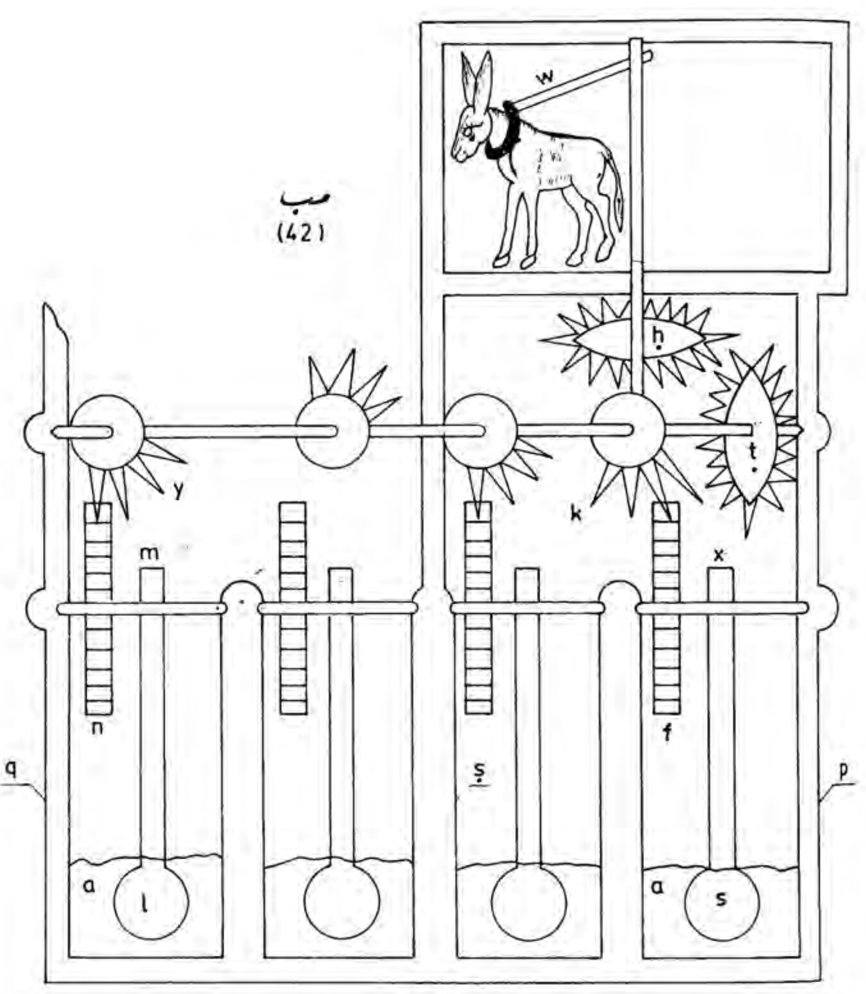


Fig. 2 b
(based on plate 42 صب of MS. 3606, from the Museum of Fine Arts, Boston)

between the illustrations reproduced here and the one based on the Bodleian Manuscript lies in the location of letters *n*, *y*, *k*, and *f* which denote wheels rather than axles, and in the location of letter *w* which denotes the transverse lever-arm rather than the vertical shaft.

Device 2 of Category V

Figs (2 a) and (2 b) illustrate the second device. They are based on plate 42 (ب) in MSS. A 3472, and A 3606, corresponding to Fig. 135 in Hill's English text. The position of the letters corresponds carefully to the Arabic text. This was checked on manuscripts A 3472, A 3606, and H 414. The main difference

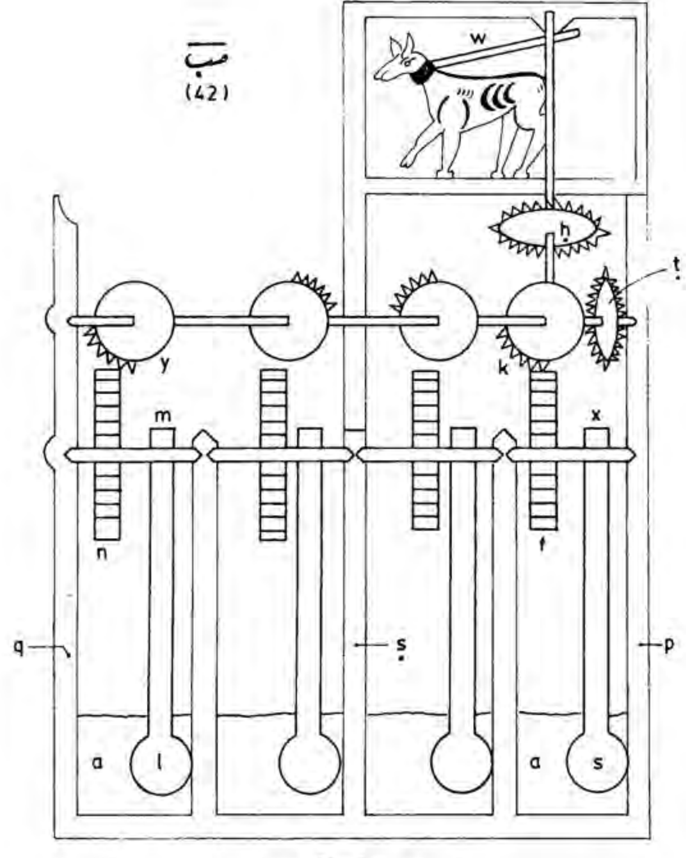


Fig. 2 a
(based on MS. A 3472)

Appendix

Explanatory Notes

Category V

Machines for Raising Water

Device I of Category V

The illustration of this machine (plate 41 ط) in the Bodleian Manuscript has the animal drawn in the upside-down position. This is Fig. 134 in Hill's book, and it has been re-drawn here (Fig. 1), with the proper Latin letters which correspond to the Arabic ones according to Hill's convention.

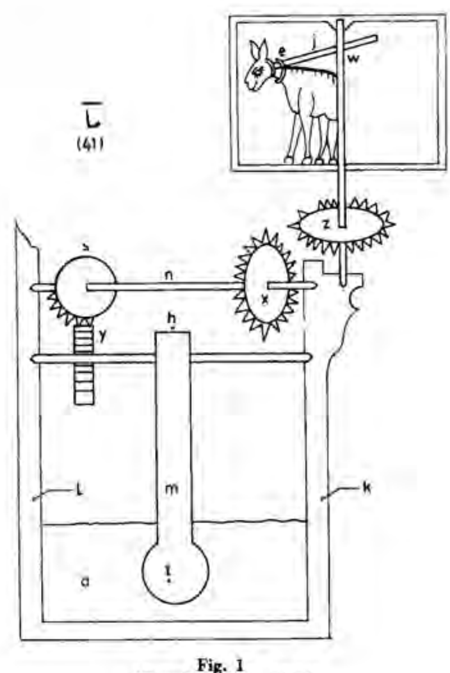


Fig. 1
(Based on MS. 3472)

The Bodleian manuscript (Graves 27) which was used for the dispersed German translation by Wiedemann and Hauser and for the complete English translation by Hill, dates back to 891 / 1486. Judging from the illustrations accompanying the text reproduced here and based on the Istanbul manuscripts, we can safely conclude that the above three copies which pre-date the Bodleian copy have better and more accurate illustrations.

After taking the above points into consideration, it was decided to edit an Arabic text based on these four manuscripts. The Bodleian copy was included since it was the basis for the German and the English translations.

A sample of the edited text appears in this issue. The part dealing with water-raising machines has been published here. Outline drawings mainly based on the illustrations of MS. A 3472 accompany the text. This was done in order to replace the secret symbols which al-Jazarī used in his illustrations with normal Arabic letters of the alphabet. This problem does not exist in the Bodleian manuscript which used the normal letters of the alphabet.[10] Furthermore, these outline drawings are supposed to clarify the original drawings by giving attention to the main details.

A major feature of this edited Arabic text is the reproduction of the illustrations of MS. 3472 in colour by offset printing. We hope that the illustrations reproduced will match the original ones as nearly as possible. It was felt rightly that the black and white reproduction could not convey the correct interpretation and details of a machine. Engineering drawings in the modern sense were not yet known. Al-Jazarī relied on colours to differentiate between different machine elements in his attempt to convey the whole concept of a machine in a single illustration.

It is natural that the edited Arabic text will throw light upon points which were incorrect or obscure in the Bodleian manuscript, and which were sometimes reflected in the German and in the English translation. The Arabic text will be accompanied by an English section outlining the major points which the Arabic text reveals. Minor errors in the Bodleian copy will not be discussed in the English section.

To enable readers to use both the Arabic text and Hill's English translation, a glossary of Arabic-English terms has also been included. Similarly an English-Arabic glossary is included for the benefit of Arab scholars and institutions involved in decisions about the proper Arabic terms in modern Arabic technical literature. Until now classical Arabic technical terms have not been available for this purpose, and it is felt that such technical terms as those used by al-Jazarī will disclose a wealth of useful terms for modern usage.

Since the editing of this work is still in progress, readers may send their comments and suggestions to the author for consideration.

10. al-Jazarī used twenty-one letters of the alphabet. In his illustrations he adopted symbolic letters to replace the normal Arabic letters, and he called these al-abdāl (الأبدال) i.e., the replacements. "These replacement letters (al-abdāl) are active ones, and they can be understood by the learned only and they are camouflaged with twenty-one false symbols or letters to mislead the ignorant".

The Institute for the History of Arabic Science (IHAS), was able to secure microfilms of all manuscripts known to exist of al-Jazarī's work. They have been listed in this paper. From a comparison of these manuscripts, we found that the three best copies are the following:[5]

1. Topkapi, Ahmet, III, 3472
2. Topkapi, Hazine, 414
3. Hagia Sophia, 3606

All three copies are in Istanbul, and it is possible that either they were not known to Wiedemann & Hauser and to Hill, or that they were not available.

MS. A 3472 is probably the earliest. It is a rather complete one, probably written c. 602 / 1206. The date of this manuscript must be further explored.[6] But from our examination of the copy we think it is a very fine one, both in handwriting and in the quality and accuracy of illustrations, and the author thinks that it is the best available copy of al-Jazarī's treatise.

IHAS was fortunate to receive a black and white negative microfilm and a coloured microfilm of this manuscript from Professor F. Sezgin.[7]

Manuscript H 414, dates back to 672/1274. Its quality is comparable to the previous copy. According to Schioler,[8] this manuscript had not been listed in any of the catalogues, and he regarded it as the second-best of all al-Jazarī's manuscripts, (i.e. second to MS. 3606 according to his judgment). It was possible for IHAS to secure a microfilm from the Institue of Arabic Manuscripts, Arab League, Cairo.

Manuscript A 3606 is also a very fine copy. It dates back to 755 / 1354. Some authors considered it the best available copy. It is however not complete. Many illustrated pages were detached from it. These very beautiful miniature paintings became known as the "automata miniatures", and several papers were published about them.[9] Although it is incomplete, this copy is still very useful in the editing of the Arabic text.

5. In his above mentioned review, David A. King recommended the study of MS. Topkapi A 3350. This copy was studied and its illustrations were found of much inferior quality (as to technical accuracy) At the same time it is dated 863 / 1459 and it is thus considerably later than the three main manuscripts utilized in preparing the present Arabic edited text.

6. King gives in his review an argument about the date 602 / 1206 of MS. Topkapi A 3472. This matter is under consideration and further information will be published with the completed Arabic edition which is under preparation.

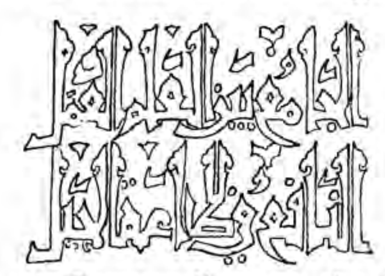
7. IHAS expresses its gratitude to the Minister of Culture, Ankara, Turkey, and to the Director of the Topkapi Library who kindly gave their permission (through Prof. Sezgin) to publish this manuscript.

Professor Sezgin suggested that IHAS should publish a facsimile edition of MS. 3472 in colour. After careful study of Category V on water-raising machines, it was found more useful to scholars if an edited text were published. This would hopefully avoid some obvious errors in the manuscript, and it would be possible to edit the illustrations and ensure their consistency with the text. It was decided however to publish all the illustrations of MS. A 3472 in colour.

8. Schioler, Thorkild, *Roman and Islamic Water-Lifting Wheels*, Odense University Press, 1973.

9. Riefstahl, M. R., "The Date and Provenance of the Automata Miniatures", *The Art Bulletin*. II (1920) 206-214.

The Arabic Text of al-Jazarī's



"A Compendium on the Theory and Practice of the Mechanical Arts"

AHMAD Y. AL-HASSAN*

Scholars have long felt that the Arabic text of al-Jazarī's book on mechanical devices written c. 1200 should be published. With the publication in 1974 of the English translation by Donald Hill[1] this feeling was revived. Thus in his review of this translation, King[2] explicitly expressed the need for the Arabic text.

Al-Jazarī's treatise has been translated into German by E. Wiedemann and F.Hauser.[3] Their translation was published in different journals between 1908 and 1921. Both Wiedemann and Hauser rendered a great service to the history of Arabic and Islamic science and technology. Hill's English translation which came more than fifty years after the Wiedemann-Hauser German version, was greatly welcomed since it offered in a single volume the complete work in English, with detailed explanatory notes. This could not have been achieved without the appearance of a "rare bird of a scholar" like Hill who has a deep interest in Arabic technology and a "unique combination of qualifications as an engineer and an Arabist".[4]

It was unfortunate however that Wiedemann and Hauser had used the Bodleian manuscript only, and that even Hill fifty years later, also mainly relied on this manuscript. This was due to the unavailability of the Istanbul manuscripts.

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1. Ibn al-Razzāz al-Jazarī, *The Book of Knowledge of Ingenious Mechanical Devices*. Translated and annotated by Donald R. Hill. Reidel, Dordrecht, 1974.

2. King, David A., "Medieval Mechanical Devices", a review of the English translation of al-Jazarī by Hill. *History of Science*. 13 (1975) 284-289.

3. Wiedemann, Eilhard and Hauser, F., "Über Vorrichtungen zum Heben von Wasser in der Islamischen Welt", Beiträge zur Geschichte der Technik und Industrie. Jahrbuch des Vereines Deutscher Ingenieure, 8 (1918) 121-154.

4. In addition to King's review of Hill's Translation, the following review is also of importance: Derek de Solla Price, *Technology and Culture*. 16 (1975) 81-83.



Fig. 2 : *Reproduced by kind permission of the Biblioteca Laurenziana, Florenca.*

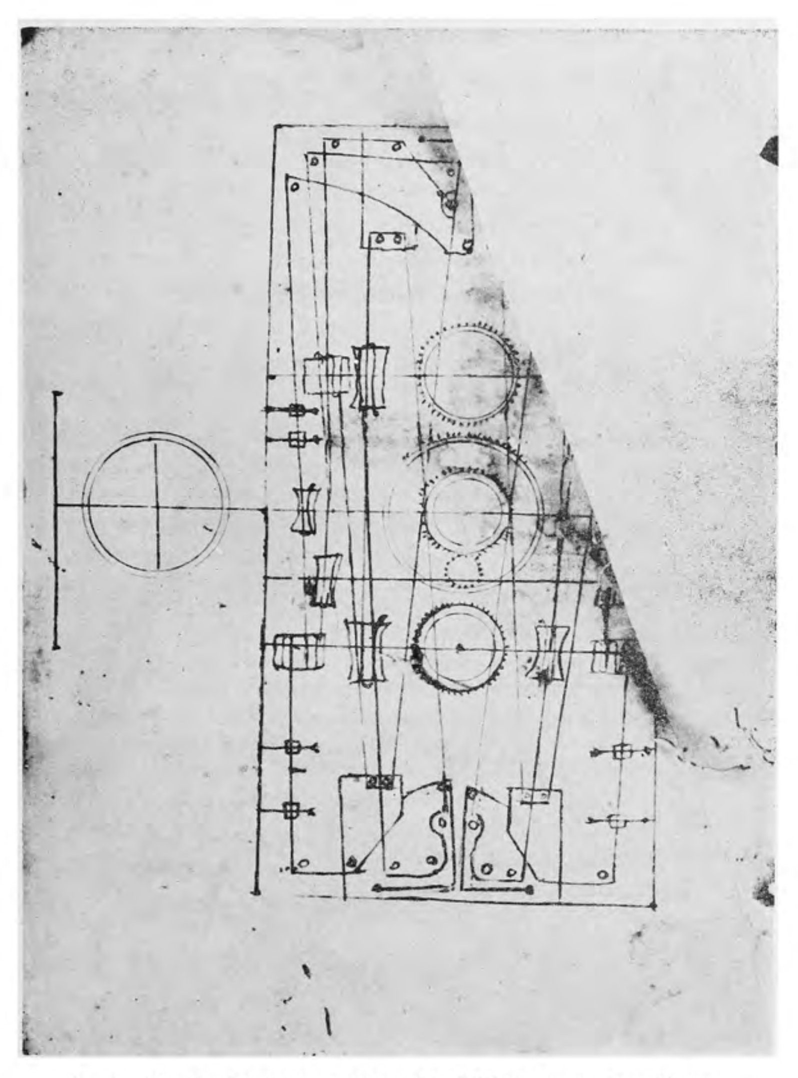


Fig. 1 : *Reproduced by kind permission of the Biblioteca Laurenziana, Florence.*

wheel = *dawlab* or *dawlāb* = دولب أو دولاب

Page 40 Description of mirrors, of 'fine white glass' is on 15 R. It reads :

[ويكون في كل جزء] مرآة من زجاج أبيض رقيق

concentric siphon = *ka'ʾs al-ʿadl* = كأس العدل

reservoir = *khizāna* or *maḥbas al-māʾ* = خزانة أو محبس الماء

outlet = *jazʿa* or *majfar* = جزعه أو مجفر

Page 41 objects = *ashkāl* = أشكال

This necessarily brief and sketchy outline of the contents of the treatise naturally omits much of importance, but it is hoped that it fulfils its purpose in bringing this crucial work on machines to the attention of scholars. It seems reasonable to advance the hypothesis that there were two distinct traditions of mechanical technology in medieval times in Europe and Western Asia. The eastern tradition, represented by the Banū Mūsā and al-Jazarī, although it included water-raising machines and large water-clocks, was characterised by the use of delicate mechanisms and subtle hydraulic and pneumatic controls. The western tradition was common to Europe, North Africa and Andalusia — i.e. it was applied both in Christendom and in Islam and placed much more emphasis on large machines with powerful prime movers. Of course, the two traditions were not wholly different, nor was the one unaffected by the other. Nevertheless, the hypothesis of the two traditions may help us to avoid the assumption that the development of a heavy machine technology was mainly a European phenomenon.

Notes for Translation into Arabic

So that there shall be no ambiguities in the translation, the following list of words and phrases, referred to in the pages of the typescript, is provided for guidance.

Page 36 box = *ṣandūq* = صندوق

Page 39 cross = *ṣalīb* = صليب

tube = *qaṣaba* = قصبة

mercury = *zībaq* = زبق أو زئبق

raṭl = رطل

lantern-pinion = *dawlāb dhū ʿawāriḍ* = دولاب ذو عوارض

tooth = *dandānja* = دندانجة

Page 38 *falak* pl. *aflāk* = فلك ج أفلاك

wheel = ʿajala = عجله

Sentence about the noria reads in the original (on 5 V) :

فلتعمل فلك شبيه النعورة [وهو فلك زح] فان كان الماء قليلا كان على شبيه الساعورة التي تدير الأرحى.

water conflicts with the required change in the hydrostatic formula.[13] Instead the objects must have been below the datum line, a positioning indicated by the writer, who says that they were 'in the water'. As mentioned above, this clock, Model 8, had a set of twelve mirrors, one of which was illuminated every hour — a very similar system to the glass roundels in al-Jazarī's first clock. In the nights the displacing weights were changed, as was the direction of the wheel that uncovered the mirrors, and a lamp was kindled in the box-like structure.

Figure 2 shows Model 10 (17v-18v), whose main release mechanism is of interest since it is a copy of the ball discharging device in the 'Archimedes' clock. A wheel is fixed to a vertical axle and has twelve equally spaced holes, each one fingerbreadth in diameter, bored through its surface near its circumference. Close below this is a static wheel that does not touch the axle; in its surface is a single hole that coincides with the holes in the upper wheel as they pass over it. A channel from this hole leads to the head of a figure. One ball is placed in each of the twelve holes in the upper wheel, so that as this wheel rotates a ball reaches the lower hole every hour and runs through the channel and is ejected from the figure's mouth. Fixed to the same axle, below these two wheels, is a cogwheel 2 spans in diameter; it has a groove on its perimeter to receive the rope which passes over a system of pulleys to the float in the clepsydra. Another cogwheel, also of 2 spans diameter, meshes with the first cogwheel. It operates a mercury balance and a system of pulleys, ropes, and weights for turning the head of the figure of an astrolabist — the precise operation of these mechanisms has not yet been determined. It is apparent however, that these mechanisms were quite sophisticated and contrast markedly with the relative crudeness of the clepsydra itself. It is strange that the engineers whose work Ibn Muᶜādh was describing knew of the ball-release in the 'Archimedes' clock, yet did not adopt the elegant system of outflow control described in the same work.

13. In a vessel of uniform cross-sectional area A, let the datum be height H above the orifice and the end of the scale height H_0. Let the height for a given day on the scale be H_1. If t is the time taken for the water to fall from H to H_0, and t_1 the time from H_1 to H_0 then, assuming the coefficient of discharge and the area of the orifice remain constant:

$$t = k\ A\ (H^{\frac{1}{2}} - H_0^{\frac{1}{2}})$$

and
$$t_1 = k\ A\ (H_1^{\frac{1}{2}} - H_0^{\frac{1}{2}}) \quad (1)$$

where k is a constant.
If water is poured in up to height H_1 and the cross-sectional area of the vessel is reduced from the bottom to H, to a uniform cross-sectional area of A_1, then

$$A_1 = A \cdot H_1/H. \quad (2)$$

It is impossible to reconcile (1) with (2), so the displacing weights must have been used to reduce the cross-sectional area of part of the vessel only. It is very probable that the correct times were arrived at by trial and-error, since the formula given in (1) above was almost certainly not known at the time of Ibn Muᶜādh. At least 150 years later, al-Jazarī used empirical methods to obtain the correct rates of discharge for different static heads of water (24-25).

The summer solstice was at the top of these divisions and the winter solstice at the bottom. The months were then subdivided into the correct number of days. The table was engraved on the side of the clepsydra for a length corresponding to a fall in the water-level in a period of fifteen hours, this being the accepted time for the hours of daylight in the latitude of Cordoba at the summer solstice. There was an unmarked section at the bottom of the vessel so that an adequate static head was maintained over the orifice on the shortest day. Every day the clepsydra was filled to the mark corresponding to that day, and in the night to its nadir. (There is a drawing of the divisions on 26 v). On the surface of the water there was a float. This float is also called a *falak*, a designation which might lead to some confusion. It is clearly a float, however, because it was weighted, probably with sand (see al-Jazarī 28)[12], until it was almost submerged in the water. The rope which provided the drive for the mechanisms was tied to a ring on the top of the float.

Clearly, some further refinement was required in order to keep the distance fallen by the float constant throughout the year, while allowing the speed of its descent to vary from day to day. In the clocks of the pseudo-Archimedes, Muḥammad al-Sāᶜātī and al-Jazarī this was achieved by using a float-chamber and flow-regulator, although only al-Jazarī was able to make the system completely accurate. No mention of such a system occurs anywhere in this treatise, but a passage on 15v, although it is somewhat obscure and partly defaced, indicates how the adjustment was made. When the clepsydra had been graduated, the mark for the longest day was taken as the datum, i.e. the start position for the float's travel every day. On the longest day the vessel was filled to this line. The gears and transmission systems were sized so that the time-recording devices tripped twelve times in the period taken by the float to complete its full travel. On other days the water was poured in up to the level corresponding to the day in question on the scale, then raised to the datum line by placing solid heavy objects in the water. There was a set of large objects *(ashkāl)*, and a set of small ones, so that the correct displacement could be obtained for the different periods of daylight by varying the combinations of objects that were placed in the water. In fact, the changes were not made daily, but at intervals of four days, so the number of objects in each set need not have been large. The writer does not specify the exact number, but says 'three, four, or five, or any number we wish'. It would not have been possible to have achieved correct results by reducing the cross-sectional area of the clepsydra over its full working length by different amounts for each four-day period, because such a change in the volume of the

12. Al-Jazarī's monumental clock was accurately reconstructed for the Science Museum, London, for the 1976 World of Islam Festival. It was found necessary to pour sand into the float until its total weight was 9 pounds (about 4 kg.), before the weight of the float was sufficient to drive the mechanisms. The reconstruction of the clock is to be described in a paper for the *Journal of the Antiquarian Horological Society*, by myself and Mr. P. N. Haward, the craftsman who built the clock.

wheel, is almost intact. The setting of three sets of teeth is described (page 7): one set is on the outer perimeter, and two are on the inside, 'facing the axle'. Without any question, therefore, these machines contained segmental gears. It is not quite so certain that they contained epicyclic gearing, but taking the illustrations and the surviving parts of the text together there seems little room for doubt. Surely, no-one interested in the history of machines and clockwork can examine Figure 1 without a sense of excitement, since it shows a system of gears for transmitting torque that is much more complex than any other power-driven gears known to have existed so early. Its most obvious ancestor is the Antikythera geared calendar[11], but this was a delicate manually operated device, not a water-powered machine in which the main cogwheel was three spans in diameter.

The clocks, Models 6-20 and 27-30 are all water-clocks except No. 29, which is a clock having lamps, one of which lights up every hour. The water-clocks all have the same basic driving system, together with a set of mechanisms for transferring the movements to the automata. The automata are of the usual types, already familiar from the works of other Arabic writers: doors that open to reveal figures, figures that discharge pellets from their mouths, figures that move their heads and arms, etc. Model 8 has a set of mirrors of 'fine, white glass', in the original:

(ويكون في كل جزء) مرآة من زجاج أبيض رقيق

one of which is illuminated every hour. The figures are on the outside of large box-like stuctures that house the mechanisms and the water reservoir. All the clocks record the passage of temporal or solar hours, i.e. the hours of daylight and darkness are divided by twelve to give hours that vary in length from one day to the next. The water-machinery is described most fully, although with some obliterations, for the mirror clock (Model 8, 15r-v). It is a cruder device than that used by al-Jazarī, being simply an outflow clepsydra of constant cross-section in which the outlet is a small concentric siphon *(kaʾs al-ʿadl)*. In the other Arabic works the reservoir is called *khizāna*, but here the term is *maḥbas al-māʾ* and, instead of *jazʿa*, the outlet is called *majfar*. To graduate the clepsydra it was filled with water while the outlet was blocked, then the outlet was opened and the outflow was allowed to continue for a full day. As the water discharged, marks were made on a vertical line on the inside of the vessel at the passing of each hour. On either side of the vertical line, at right angles to it, horizontal lines were drawn for each month, according to the known length of daylight at the start and finish of each month. There were thus six divisions on each side of the line – the horizontal lines did not coincide as they would have done if the division had been into zodiacal 'houses'.

11. Derek de Solla Price, *Gears from the Greeks* (Science History Publications, New York, 1975), *passim*.

clock. We must therefore now qualify Needham's statement that there is no evidence for any Arabic influence on Chinese developments, and that the Arabic material indicates the passage westwards of certain Chinese elements.[9] As far as water-wheels and their use are concerned, it would be premature to draw any conclusions at all about transmissions between cultural areas. The question of the diffusion of water-wheels, horizontal and vertical, from Roman times onwards, is still hedged with confusion, and there is no space here to enter into a discussion of this topic. It is worthwhile, however, to take note of three points :

1. The use of both types of water-wheel was widespread in Islam from the 3rd/9th century onwards.[10]
2. The machines described by Ibn Muᶜādh show that water-wheels were used by the Arabs for other purposes besides the driving of corn-mills.
3. Al-Jazarī, writing in 602/1206 mentions an old machine which he inspected, in which a musical automaton was powered by a vertical water-wheel. In his comments on this machine he clearly implies that he knew how to control the speed of such a wheel by means of an escapement. (p.170)

On present evidence, therefore, it seems just as likely that the idea of using an escapement-controlled water-wheel to drive a clock moved from Islam to China as that the transmission was in the reverse direction. In any case, the idea was never developed in Europe, where the importance of water-wheels lies in their application to milling and industrial uses. The spread of the water-wheel and its application has yet to be intensively studied with reference to all cultural areas. At present it seems a reasonable hypothesis that the spread of both types of wheel was continuous from Roman times to the Middle Ages in Europe, Western Asia and North Africa, and that the uses to which the wheels were put varied according to social and economic needs. There is also reason to suppose that the selection of the type of wheel to be used was not haphazard, but rather that the choice was consciously made to suit the local hydraulic conditions.

Returning to Figure 1, the noria was mounted on an axle that passed into the box and rested in bearings fixed to its walls. The main central gear-wheel was on this axle. This wheel had 64 teeth on half its perimeter, and meshed with the two outer cogwheels, each of which had 32 teeth around its complete perimeter, and had a diameter equal to one quarter of the diameter of the large wheel. Each of the smaller wheels therefore made two rotations for one rotation of the large wheel. The description of the wheels inside the main wheel is badly defaced. The description of the main wheel for Model 4, however, which is very similar to Model 5 except that there is no central cog-

9. Joseph Needham, *Science and Civilisation in China*, Vol.4, Pt. 2 (Cambridge University Press, 1965) p. 536.

10. Norman Smith, *Man and Water* (Peter Davies, London, 1976), p. 142.

is different from the others and I have so far not been able to establish how it works. The remaining four, from page 3v to 11v, are all similar and contain features of the first importance for the history of mechanical technology.

Figure 1 is the illustration from Model 5, which is the most complex of these machines. The others contain some, but not all, of the mechanisms shown in Figure 1. (It has, however, been necessary, because of obliterations, to study all the four Models in order to deduce their essential features). The purpose of Model 5 was to cause a set of doors, set in a row, to open at successive intervals, revealing jackwork figures. These doors were on one side of the usual boxlike structure that contained the working parts. The prime mover was a waterwheel, mounted in a stream outside the box – in Figure 1 this is represented by the circle with a double perimeter to the left of the illustration. This is called a *falak* pl. *aflāk*, a term which requires some explanation. *Falak* usually means the celestial sphere and is used by al-Jazarī, for instance, for the large disc carrying representations of the sun, moon, and zodiacal signs which rotates at constant speed at the top of his monumental water-clock (Category 1, Ch. 1). Ibn Muʿādh does not use the word in this sense only, and it is important to emphasise that most of his *aflāk* are not for display, and are not analogous to the geared planetaria displayed on the outside of de Dondi's clock.[8] The *aflāk* in this treatise are anything that simulates celestial motion by mechanical means, namely the prime movers and their associated gears and wheels. A *falak* may be a gear-wheel, a water-wheel, or even a float! (See below). The word is often qualified, e.g. 'a *falak* like a wheel (*ʿajala*)' and in the present case it is like a noria: "we make a *falak* on the pattern of the noria (*nāʿūra*) and if the flow of water is scanty it is like the noria (naʿūra) which turns the mills" (5v) In the text it is.

فلنعمل فلك شبيه النعورة (وهو فلك زح) فان كان الماء قليلا كان على شبيه الناعورة التي تدير الارحى

(Note that the spelling of noria varies; this happens with other words – e.g. *dawlab* and *dawlāb* are both used for a wheel). This remark seems to indicate that Ibn Muʿādh was recommending the use of an overshot wheel if the flow was small, since this type of wheel is more efficient than the undershot type in such conditions. This implies that the engineers of the 5th/11th century were aware of the necessity for varying the design of the water-wheel to suit the flow conditions. Of greater significance, however, is the use of a full-size water-wheel to power a large machine. This brings us directly to the monumental water-clock of Su Sung, who flourished in China some decades later than the time of Ibn Muʿādh. Now, admittedly, Su Sung's water-wheel was furnished with an escapement and it provided the power for a clock, but it is nevertheless evident that Ibn Muʿādh's devices are basically similar to Su Sung's

8. Silvio A. Bedini and Francis R. Maddison, "Mechanical Universe, the astrarium of Giovanni de Dondi", *Transactions of the American Philosophical Society*, N.S., lvi, 5 (1966).

The important ideas incorporated in the prime movers can be identified with some confidence, but it has proved impossible so far to discover precisely how the motion was transferred to the automata. We can be fairly sure, however, that these mechanisms were basically similar to those described by Riḍwān and al-Jazarī. Boards were mounted in the box to carry the pulleys and other mechanisms for transferring power. On the axle of the last wheel in the driven chain there was often a cross *(ṣalīb)* whose purpose is not yet clear to me. The automata themselves were also similar to those that are found in other Arabic works, e.g. doors that open each hour to reveal standing figures, figures that move their heads and limbs, etc. A novel feature in this treatise, however, is Ibn Muᶜādh's use of mercury in balances (e.g. Model 1,2 r). He says, apparently assuming that his readers were familiar with such devices, that the tube *(qaṣaba)* of the balance has mercury *(zībaq)* inside it. Perhaps its purpose was similar to that of the lead ball placed by al-Jazarī in the tube of a balance-arm. (e.g. Category IV, Ch. 5). When the balance tilts, the ball or the mercury runs to the lower end and holds the balance in that position until it is made to tilt in the opposite direction. This use of mercury suggests a link between this treatise and later Christian works on similar subjects, since the *Libros del saber* contain a clock operated by mercury[7].

Ibn Muᶜādh's machines are notable for their sheer size and power. This feature, which is brought out in the ensuing discussion, distinguishes the work sharply from that of the Banū Mūsā, with its emphasis upon delicate mechanisms and controls, and from those machines of al-Jazarī which embody similar concepts. In Ibn Muᶜādh's work there are no conical valves, delay systems, feedback controls, or use of small variations in atmospheric pressure — all the ideas, in fact, that have until now been regarded as typical of Arabic mechanical technology. The element of intermittent operation is not of course absent from the present treatise – indeed it is of the utmost significance – but it is achieved by different means. Delicacy is replaced by ruggedness: we have ropes instead of strings; large wheels up to 3 spans in diameter (about 72cm/28 inches); spanning weights up to 1½ *raṭls* (say at least 3 kg); with other weights and dimensions in proportion. Gearing is important, and in addition to the special gears discussed below we find all the usual types: parallel meshing, meshing at right angles, worm-and-pinion. For parallel meshing the lantern pinion *(dawlāb dhū ᶜawāriḍ)* is used for one of the two wheels, as it was by al-Jazarī. On page 28 we have the important statement that the teeth of cogwheels were cut to the shape of equilateral triangles, proving that they were true teeth and not wooden pegs. As usual, the word *dandānja*, of Persian origin, is used for a tooth.

We now come to the kernel of this paper, namely the prime movers of the automata machines and the water-clocks. Of the first five models, No. 1

7. See Wiedemann and Hauser, "Über die Uhren", 18-20.

the quality of the illustrations can vary enormously among the various manuscripts, to the extent that one copy may contain all the faults listed above, and another none.

The manuscript is written in a clear *maghribī* hand and is easily legible; consonantal points are usually provided. The grammar is accurate. The vocabulary presents little difficulty, although some of the expressions used are different from those used for the same objects in the works of other Arabic writers and translators, but the differences are relatively few when compared with the parallels. In particular, nearly all the words used for the mechanical parts are the same as those occurring in the works of the other writers.

Ibn Mu^cādh's method of presentation demonstrates clearly his inclination towards geometry rather than engineering. First, the operation of the device is described in three or four lines: typically, a man holding an astrolabe turns his head towards a slave-girl, whereupon she ejects a pellet from her mouth (a less elegant variation of the birds used by 'Archimedes' and al-Jazarī). Then the Model is described in geometrical terms. Usually the main structure is a box *(ṣandūq)*, rectangular in cross-section, with the shorter dimension two thirds of the longer. Lines are drawn on the illustration, these lines being identified by letters, many of which, as mentioned above, are omitted from the illustrations. Nominally, the drawings are elevations, but parts are shown from any view which suits the draughtsman's purpose. Thus all wheels are drawn as full circles, including cogwheels meshing at right angles. When these lines have been drawn the axles, wheels, and other components are placed on the drawings with reference to the lines, somewhat in the manner of a mapmaker plotting features on a basic grid. Throughout the treatise, details of construction are almost totally lacking: all we are given are phrases such as 'we place wheel (kl) on axle (ty)' or 'the ends of the axle are on points (ew)', and so on. Occasionally materials such as wood and copper are mentioned, but with no instructions about how they are to be cut, formed and jointed. On the other hand, dimensions and weights are often supplied, either directly or in relation to other components. Care is taken, for example, to specify the relative sizes of meshing cogwheels and the number of teeth on each of them.

The following sequence for the descriptions of the various parts of the machines is usual: the box-like structure with its lines is described first, then the placing of the main wheels and axles, followed by the means of imparting motion to them, and finally the description of the systems of ropes, pulleys and cams that activate the automata. Unfortunately, Ibn Mu^cādh does not follow the example of the Banū Mūsā and al-Jazarī who, having given a description of the construction of a machine, conclude with a clear summary of how it works and how the various mechanisms interact with one another. This lack of a summary is particularly frustrating, because such a summary would have helped to make up for the obliterated passages.

and the water-clocks, pending a more thorough examination of the entire treatise.

Every page is partly obliterated, either being cut or affected by dampness. On average about 40% of each page is affected: the verso pages are worse than the recto, since usually about half the page to the right of the main diagonal is missing; the recto pages have been affected by damp along their right-hand margins, to the extent that about 30% of the text is missing or illegible. This means that no page can be read in its entirety. By taking a selection of passages from different Models, all describing a similar mechanism or technique it is sometimes possible to make a plausible reconstruction of what is being described, particularly when the concept is known from the writings of other Arabic authors. A careful and protracted study on these lines may one day permit us to make a fair assessment of the treatise, but failing the discovery of a better manuscript, a full explanation of each of the Models may never be possible. In the first place, some passages describing similar mechanisms are partly obliterated wherever they occur. Thus none of the descriptions of the very significant gear-trains in Models 2-5 is complete, and some vital concepts embodied in this gearing must therefore be conjectured. Secondly, some systems are described fully only once, and subsequent brief mentions of the same system refer back to the key passage. A notable example of this is the basic water machinery of the clocks, which is described in detail only in a partly obliterated section of Model 8. Thirdly, the descriptions are far too short in view of the size and complexity of the machines. For instance, the length of the descriptions for each of Ibn Muᶜādh's clock is only a small fraction of the lengths of the descriptions in Archimedes[3], Riḍwān,[4] and al-Jazarī,[5] for clocks of equivalent complexity. Finally, the illustrations are badly drawn and quite inadequate, even when they are intact. Identifying letters are often omitted, the drawing of the transmission systems is haphazard and almost impossible to unravel, and no detailed drawings are provided. The omission of all drawings of human and animal figures adds a further element of uncertainty. All these defects, except the omission of detailed drawings, are probably the fault of the copyist rather than of the author. We know, from the extant manuscripts of the works of the Banū Mūsā[6] and al-Jazarī, for example, that

3. Donald R. Hill, *On the Construction of Water-clocks* (Turner and Devereux, London, 1976).

4. Eilhard Wiedemann and Fritz Hauser, "Über die Uhren im Bereich der islamischen Kultur", *Nova Acta Abh. der Kaiserl. Leop. Carol Deutschen Akademie der Naturforscher* 100 (Halle 1915) 176-266.

5. Donald R. Hill, *The Book of Knowledge of Ingenious Mechanical Devices* (Reidel, Dordrecht 1974) (All the references to al-Jazarī in this paper are taken from this book).

6. Fritz Hauser, "Über das Kitāb al-Ḥiyal - das Werk über die sinnreichen Anordnungen der Banū Mūsā", *Abh. zur Gesch. der Naturwissenschaften und der Medizin*, Erlangen, 1922.

Wiedemann and Hauser, "Über Trinkgefässe und Tafelaufsätze nach al-Gazarī und den Banū Mūsā", *Der Islam* 8 (1918), 268-291.

(An annotated English translation of the Banū Mūsā's *Kitāb al-Ḥiyal* has been prepared by the present writer and will be published by Reidel of Dordrecht).

discussed more fully below. Also, the length of daylight is given in the treatise as fifteen hours, for the day of the summer solstice. This corresponds to the latitude of 40 degrees, whereas the latitude of Cordoba is 37 degrees 53 minutes. If, however, the apparent times of sunset and sunrise, due to refraction, were used then the time would be very close to fifteen hours. It is almost certain, therefore, that the treatise was written in Cordoba by someone well versed in mathematics and astronomy, but with little engineering knowledge. This, together with the location of the treatise among other works attributed to Ibn Muᶜādh, puts the burden of the argument upon those who would ascribe its authorship to another hand. For the remainder of this paper it is assumed that the author was indeed Ibn Muᶜādh.

My purpose here is to draw the attention of scholars to the existence of this primary source for the study of medieval Arabic technology, to list briefly its contents, and to emphasise some of its most significant contents. Because of the poor state of the manuscript a long and careful study will be required before a more thorough assessment of the work's unquestionable value can be made. It is important however, that this preliminary notice be written, not least because some of the concepts embodied in the treatise have been thought not to have occurred in Arabic writings, and their introduction has been assigned to other cultural areas.

The manuscript is dated 644/1266, and although the text is probably a faithful copy of the original, the illustrations are almost certainly inferior to those that were drawn by, or under the guidance of, Ibn Muᶜādh. It is particularly unfortunate that all representations of human and animal automata have been omitted (see below), an indication that the austere influence of the Almohades *(al-muwaḥḥidūn)* was still powerful in western Islam in the middle of the 7th/13th century. One or two of the leaves in the first part of the manuscript seem to be out of order, but it has not yet been possible to re-arrange these with confidence. This minor fault in the sequence is probably of recent occurrence but there is also some slight disorder from an earlier time. On folio 5v, for instance, there is a note in Arabic by the side of the illustration in different handwriting from that of the main text, saying that the text and illustration refer to Model 2, whereas they are paginated under Model 3. This is indeed the case.

The treatise, on folios 1v-46r, consists of 31 Models of which Nos. 1-5 are essentially very large toys, similar to clocks in that automata are caused to move at intervals, but without precise timing. Nos. 6-20 and 27-30 are water-clocks, all of which record the passage of the temporal hours by the movements of automata. Nos. 21-24 are war machines in the form of towers which can be raised and lowered by a scissors action like that of 'lazy tongs'. Nos. 25 and 26 are machines for raising water from wells, and No. 31 is a universal sundial. In this paper discussion will be confined to the first five machines

A Treatise on Machines by

Ibn Mu^cādh Abū ^cAbd Allāh al-Jayyānī

DONALD R. HILL*

The work that concerns us here is part of a manuscript preserved in the Biblioteca Medicea Laurenziana in Florence[1]. Numbered Or. 152 (formerly 282), it is catalogued as *anonymi tractatus de mechanicis*. The treatise is entitled *kitāb al-asrār fī natā^ij al-afkār*, 'The book of secrets about the results of thoughts', and it occurs among a number of mathematical treatises attributed to Abū^cAbd Allāh known as Ibn Mu^cādh[2]. The *nisba* al-Jayyānī refers to Jaén, the capital of the Andalusian province of the same name. Little is known of his life. He was born in Cordoba in 379/989-90 and died later than 1 July 1079 A.D., since he wrote a treatise on the solar eclipse which occurred in Jaén on that date. He was primarily an astronomer and a mathematician. Two of his astronomical works, not known to be extant in Arabic, were translated into Latin by Gerard of Cremona. In the *Libros del saber* (II 59, 309) he is quoted as considering the twelve astrological houses to be of equal length. Several of his mathematical works are extant in Arabic, and he was regarded as an eminent and progressive mathematician by Ibn Rushd (Averroes). He was a fervent admirer of Euclid, and was the most successful of those scholars who attempted to reconcile Euclid's doctrine of proportions with Arabic concepts and methods.

The attribution of the treatise on machines to Ibn Mu^cādh cannot be fully verified but in the absence of evidence to the contrary he may be considered as its author. It might be objected that the treatise differs essentially from the mathematical and astronomical works which form the bulk of Ibn Mu^cādh's writings, although there is no reason why a mathematician should not turn his attention to mechanics. It is perhaps more to the point, however, that the writer was obviously a scientist and not an engineer. It is quite evident that he is describing machines that he had seen by a method that he understood well, i.e. that of geometry, and that he had virtually no knowledge of, or interest in, the messy business of contruction. This point is

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1. I wish to thank the Director of the Biblioteca Laurenziana for kindly providing me with the necessary photographic material, and for giving permission for the use of this material in the preparation of this paper.

2. David A. King, "Medieval Mechanical Devices", in *History of Science* 13:22 (1975) 284-289. For additional biographical material on Ibn Mu^cādh, see the article "al-Jayyānī"in the *Dictionary of Scientific Biography*, Vol. VII (New York, 1973), pp. 82-83.

TABLE 3
AL-MUHKAM TABLE OF QAZWĪNĪ

γ′	C_4 Shāṭir	Al-Qazwīnī	SIGN	0	C_6 Shāṭir	Interpolation Minutes/Seconds		
		0 $\sigma(2\eta)$ →	30′ →	60′ →	γ′	1	3	6 →
0	0; 0	8; 0, 0	8; 0, 0	8; 0, 0	0; 0	0, 0	0, 0	0,02
15	—1;11	6;49,16	6;31,46	6;14,16	—0;35	0,35	1,45	3,30
29	—2;13	5;46,39	5;13,39	4;40,39	—1; 6	1, 6	3,18	6,36
			SIGN	1				
0	—2;18	5;42,20	5; 8,20	4;34,20	—1; 8	1, 8	3,24	6,48
15	—3;17	4;42,54	3;53,54	3; 4,54	—1;38	1,38	4,54	9,48
29	—4; 3	3;57,31	2;43, 7	1;53,31	—2; 4	2, 4	6.12	12,24
			SIGN	2				
0	—4; 5	3;54,38	2;52, 8	1;49,38	—2, 5	2, 5	6,15	12,30
15	—4;39	3;20,54	2; 7,53	0;54,54	—2,26	2,26	7,18	14,36
29	—4;55	3; 5,12	1;45,12	0;25,12	—2,40	2,40	8, 0	16, 0
			SIGN	3				
0	—4;55	3; 4,36	1;44,36	0;24,36	—2;40	2,40	8, 0	16, 0
15	—4;52	3; 8,15	1;46,15	0;24,15	—2;44	2,44	8,12	16,44
29	—4;30	3;30,57	2;11,57	0;53,27	—2;37	2,37	7,51	15,42
			SIGN	4				
0	—4;27	3;32,38	2;54, 8	0;55,38	—2;36	2,37	7,51	15,42
15	—3;43	4;17,24	3; 9,54	2; 2,24	—2;15	2,15	6,45	13,30
29	—2:44	5;15,34	4;24,34	3;33,34	—1;42	1,42	5, 6	10,12
			SIGN	5				
0	—2;40	5;20,10	4;30,40	3;41,10	—1;39	1,39	4,57	9,54
15	—1;24	6;36,27	6; 9,27	5;42,26	—0;54	0,54	2,42	5,24
29	—0; 6	7;54,20	7;52,20	7;51,20	—0; 4	0, 4	0,12	0,24
			SIGN	6				
0	[0;0]	8; 0, 0	8; 0, 0	8; 0, 0	[0;0]	0, 0	0, 0	0, 0
15	1;24	9;23,33	9;50,33	10;17,33	0;54	0,54	2,42	5,24
29	2;35	10;35, 3	11;23,33	12;12,3	1;37	1,37	4,51	9,42
			SIGN	7				
0	2;40	10;39,50	11;29,20	12;18,50	1;39	1,39	4,57	9,54
15	3;43	11;42,36	13; 3,36	13;57,36	2;15	2,15	6,45	13,30
29	4;25	12;24,54	13;42,54	15; 0,54	2;35	2,36	7,48	15,36
			SIGN	8				
0	4;27	12;27,22	13;45,52	15; 4,22	2;36	2,37	7,51	15,42
15	4;52	12;51,45	14;13,45	15;35,45	2;44	2,44	8,12	16,24
29	4;56	12;55,41	14;16,11	15;36,41	2;41	2,40	8, 0	16, 0
			SIGN	9				
0	4;55	12;55,24	14;15,24	15;35,24	2;40	2,40	8, 0	16, 0
15	4;39	12;39, 6	13;52, 7	15; 5, 6	2;26	2,26	7,18	14,36
29	4; 8	12; 8, 4	13;11,34	14;15. 4	2; 7	2, 7	6,21	12,42
			SIGN	10				
0	4; 5	12; 5,22	13; 7,52	14;10,22	2; 5	2, 5	6,15	12,30
15	3;17	11;17, 6	12; 6, 6	12;55, 6	1;38	1,38	4,54	9,48
29	2;22	10;21,53	10;56,53	11;31,53	1;10	1,10	3,30	7, 0
			SIGN	11				
0	2;18	10;17,40	10;51,40	11;25,40	1; 8	1, 8	3,24	6,48
15	1;11	9;10,45	9;28,14	9;54,44	0;35	0,35	1,45	3,30
29	0; 5	8; 4,46	8; 5,46	8; 6,46	0; 2	0, 2	0, 6	0,12
I	II	III	IV	V	VI	VII	VIII	IX

TABLE 2

FIRST LUNAR EQUATION

	Shāṭir	Al-Qazwīnī			Shāṭir	Al-Qazwīnī		
		SIGNS	0	And	6			
2η		Minutes	0	△		Minutes		30 △
	Text	Text	Comp.	Min	Text	Text	Comp.	Min
0	0; 0	13; 0	13; 0	0	0;17	13;19	13;16	3
15	7;32	20;32	20;32	0	7;44	20;44	20;44	0
29	11;37	24;37	24;38	1	11;42	24;42	24;43	1
		SIGNS	1	and	7			
0	11;47	24;47	24;48	1	11;52	24;52	24;52	0
15	12; 8	25; 8	25; 9	1	12; 6	25; 5	25; 6	1
29	9;45	22;45	22;47	2	9;38	22;38	22;40	2
		SIGNS	2	and	8			
0	9;31	22;31	22;33	2	9;24	22;23	22;26	3
15	5;11	18;11	18;11	0	5; 1	18; 1	18; 1	0
29	0;22	13;22	13;21	1	0;12	13;12	13;11	1
		SIGNS	3	and	9			
0	[0;0]	13; 0	13; 0	0	—0;12	12;49	12;49	0
15	—5;11	7;49	7;49	0	—5;21	7;39	7;39	0
29	—9;16	3;44	3;42	2	—9;24	3;37	3;34	3
		SIGNS	4	and	10			
0	— 9;31	3;29	3;27	2	— 9;38	3;22	3;20	2
15	—12; 8	0;52	0;51	1	—12;11	0;50	0;49	1
29	—11;56	1; 4	1; 4	0	—11;52	1; 8	1; 8	0
		SIGNS	5	and	11			
0	—11;47	1;13	1;12	1	—11;42	1;18	1;17	1
15	— 7;32	5;28	5;28	0	— 7;20	5;40	5;41	1
29	— 0;34	12;26	12;27	1	— 0;17	12;41	12;44	3
I	II	III	IV	V	VI	VII	VIII	IX

TABLE 1

THE SOLAR EQUATION

	Ibn al-Shāṭir	Al-Qazwīnī					
		SIGN 0					
		Minutes 0		△	Minutes 45		△
	Text	Text	Comp.	Sec	Text	Comp.	Sec
0	0; 0, 0	2; 3, 0	2; 3, 0	0	2; 1,35	2; 1,35	0
15	—0;28,11	1;34,39	1;34,50	1	1;33,26	1;33,27	1
29	—0;53,17	1; 9,43	1; 9,44	1	1; 8,27	1; 8,27	0
			SIGN 1				
0	—0;55, 0	1; 8, 0	1; 8, 1	1	1; 6,45	1; 6,44	1
15	—1;19, 7	0;43,53	0;43,54	1	0;42,47	0;42,47	0
29	—1;37,55	0;25, 5	0;25, 3	2	0;24,12	0;24,10	2
			SIGN 2				
0	—1;39, 6	0;23,54	0;23,53	1	0;23, 2	0;23, 1	1
15	—1;53,33	0; 9,27	0; 9,23	4	0; 8,53	0; 8,50	3
29	—2;0 ,56	0; 2, 4	0; 2, 3	1	0; 1,59	0; 1,50	9
			SIGN 3				
0	—2; 1,13	0; 1,47	0; 1,46	1	0; 1,37	0; 1,36	1
15	—2; 0,48	0; 2,12	0; 2,12	0	0; 2,27	0; 2,27	0
29	—1;52,30	0;10,30	0;10,30	0	0;11,10	0;11,10	0
			SIGN 4				
0	—1;51,36	0;11,24	0;11,23	1	0;12, 6	0;12, 5	1
15	—1;33,35	0;29,25	0;29,25	0	0;30,34	0;30,32	2
29	—1; 9,30	0;53,30	0;53,29	1	0;54,58	0;54,56	2
			SIGN 5				
0	—1; 7,33	0;55,27	0;55,26	1	0;56,56	0;56,55	1
15	—0;35,27	1;27,33	1;27,33	0	1;29,16	1;29,16	0
29	—0; 2,24	2; 0,36	2; 0,36	0	2; 2,24	2; 2,24	0
			SIGN 6				
0	0; 0, 0	2; 3, 0	2; 3, 0	0	2; 4,48	2; 4,48	0
15	0;35,27	2;38,27	2;38,27	0	2;40, 8	2;40,10	2
29	1; 5,34	3; 8,34	3; 8,36	2	3;10, 4	3;10, 5	1
			SIGN 7				
0	1; 7,33	3;10,33	3;10,34	1	3;12, 1	3;12, 2	1
15	1;33,35	3;36,35	3;36,35	0	3;37,42	3;37,41	1
29	1;50,40	3;53,40	3;53,41	1	3;54,22	3;54.23	1
			SIGN 8				
0	1;51,36	3;54,36	3;54,37	1	3;55,17	3;55,17	0
15	2; 0,48	4; 3,48	4; 3,48	0	4; 4, 2	4; 4, 2	0
29	2; 1,26	4; 4,26	4; 4,28	2	4; 4,17	4; 4,17	0
			SIGN 9				
0	2; 1,13	4; 4,13	4; 4,14	1	4; 4, 2	4; 4, 2	0
15	1;53,33	3;56,37	3;56,33	4	3;56, 2	3;55,58	4
29	1;40,15	3;43,15	3;43,16	1	3;42,23	3;42,25	2
			SIGN 10				
0	1;39, 6	3;42, 6	3;42, 7	1	3;41,33	3;41,14	19
15	1;19, 7	3;22, 7	3;22, 6	1	3;21, 0	3;20,59	1
29	0;56,41	2;59,41	2;59,42	1	2;58,24	2;58,25	1
			SIGN 11				
0	0;55, 0	2;57,59	2;57,59	0	2;56,42	2;56,42	0
15	0;28,11	2;31,11	2;31,10	1	2;29,48	2;29,46	2
29	0; 1,53	2; 4,53	2; 4,54	1	2; 3,28	2; 3,28	0
I	II	III	IV	V	VI	VII	VIII

$\delta(\gamma, 2\eta)$. A preferable alternative is the *muḥkam* table found in Qazwīnī's zīj and described by King in the Yemeni Mukhtār Zīj[19]. It is

$$\delta'(\gamma', \sigma) = C_4(\gamma') + C_5(\gamma') \cdot \sigma + 8^0,$$

where the 8^0 insures that always $\delta' > 0$. The reason for regarding the σ rather than 2η as an independent variable is that δ' is linear with respect to σ.

Now

when $2\eta = 0^0$ or 180^0, $\sigma = 0$, and $\delta' = C_4(\gamma') + 8^0$, and
when $2\eta = 90^0$ or 270^0, $\sigma = 1$ and $\delta' = C_4(\gamma') + C_5(\gamma') + 8^0$

For intermediate values of σ, γ' being held constant, δ' can be calculated by taking proportional parts of the difference between the end values shown above, that is, proportional parts of C_5. By this means the *muḥkam* table has been computed for the domain

$$\gamma' = 0^0, 1^0, 2^3 \ldots, 360^0$$

and

$$\sigma = 0, 0;6, 0;12, \ldots, 1;0.$$

with columns of increments, $\triangle\delta'$ for

$$\triangle\sigma = 0;1, \quad 0;2, \ldots, 0;10.$$

Our Table 3 excerpts as follows:

Columns II and VI show selected entries from Ibn al-Shāṭir's C_4 and C_5. Columns III, IV, and V are from the *muḥkam* for the same set of γ' and for $\sigma = 0$, 0;30, and 1 respectively. Columns VII, VIII, and IX give $\triangle\delta'$ for $\triangle\sigma = 0;1$, 0;3, and 0;6 respectively. Note that

Column II + 8 = Column III,
Columns (II + VI) + 8 = Column V,

except for the seconds. Perhaps Qazwīnī used a version of *al-zīj al-jadīd* calculated to seconds.

Column IV is the mean between Columns III and V.

To calculate a lunar true position, obtain $\bar{\lambda}$, γ, and η from the mean motion tables for the given time. Now calculate γ' by using the E_3 table, and obtain σ from its table. With these γ' and σ enter the *muḥkam* table to get δ'. Finally,

$$\lambda = \bar{\lambda} - 8^0 + \delta'$$

with addition the only arithmetic operation.

19. King, *Centaurus*, *op. cit.*, p. 134.

To eliminate the need for interpolation, Qazwīnī drastically thickened the domain of his equation table, giving a value of e at intervals of quarter degrees, instead of Ibn al-Shāṭir's one degree. Presumably the former did not calculate the table *de novo*. He added the $2;3,0^0$ to each value in Ibn al-Shāṭir's table and filled in the interstices by interpolation *(K. al-zīj*, ff. 28r-29r).

4. *The Lunar True Longitude*

The motion of the moon is much more complicated than the sun's in that once the mean position, $\bar{\lambda}$, a linear function of time, has been calculated it must be modified by a correction, δ, involving two independent variables. These are γ, the anomalistic argument, and η, the mean elongation, both linear functions of time. In our text the lunar true longitude is given by the equivalent of the expression.

$$\lambda = \bar{\lambda} + \delta(\gamma', 2\eta)$$

where $$\delta = C_4(\gamma') + C_5(\gamma') \cdot \sigma(2\eta),$$

and $$\gamma' = \gamma + C_3(2\eta)$$

The mode of computation is Ptolemaic, but the underlying mechanism is that of Ibn al-Shāṭir — Copernicus. The standard arrangement was to present tables of four functions, C_3, C_4, C_5, and σ, each of a single variable. These are shown graphed in Figure 2. We note that the first three are sometimes negative, and that a multiplication is required to produce λ.

In the case of C_3 the matter is easily remedied by the familiar lifting device. He defines

$$E_3(2\eta) = C_3(2\eta) + 13^0$$

which is everywhere positive as seen from its curve on Figure 2. The selected entries in Table 2 are, in Columns II and VI taken from Ibn al-Shāṭir's zij (ff. 35v-36r), in Columns III and VII from Qazwīnī's, and in Columns IV and VIII from results turned out by the Harvard computer. From the difference in Columns V and IX the agreement is seen to be quite good. The domain again covers every quarter degree. Again it is necessary that a correction, here -13^0, be applied to the epoch position of γ in order to insure that the same γ' will result whether C_3 or E_3 is used.

The interpolation function σ is always positive, hence taken over unchanged.

5. *The Lunar Muḥkam Table*

The crux of the problem is the determination of δ by operations involving only the addition of tabular values. In principle this could be accomplished by calculating an enormous, everywhere positive two-argument table of

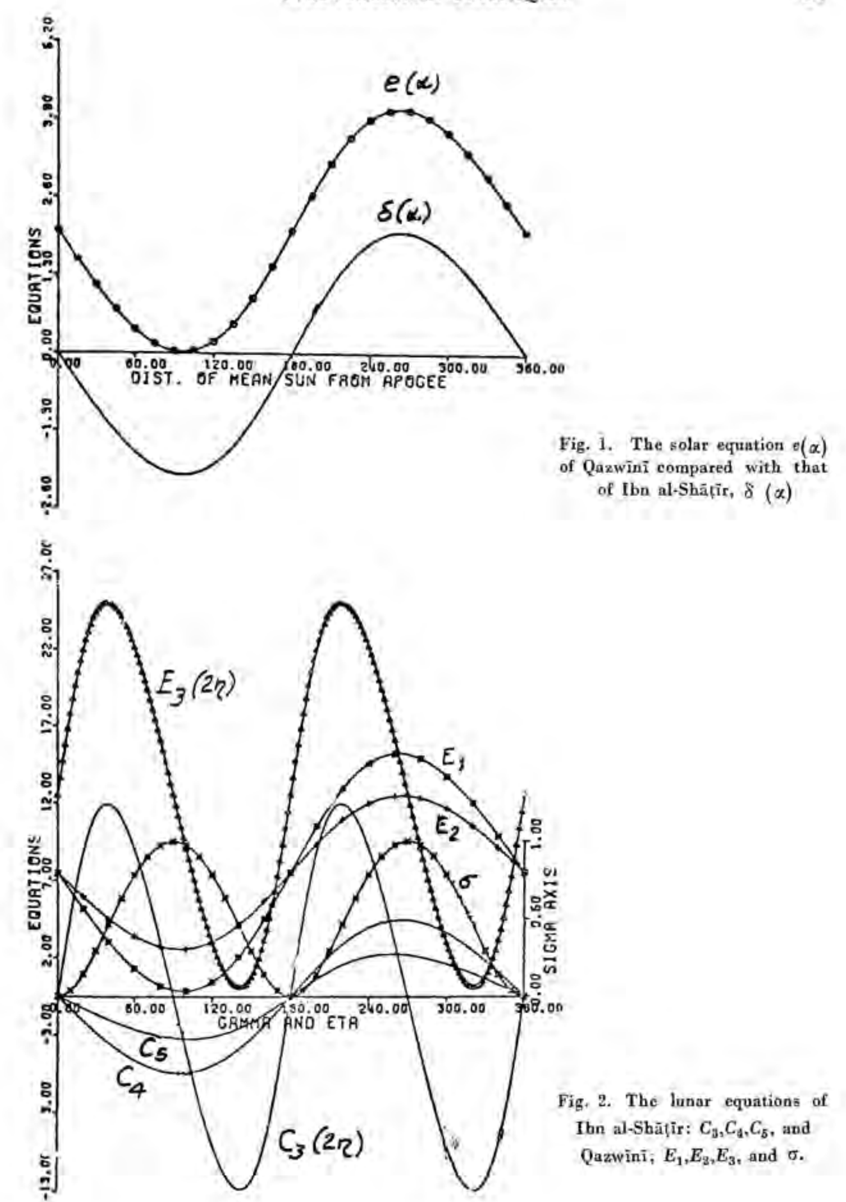


Fig. 1. The solar equation $e(\alpha)$ of Qazwīnī compared with that of Ibn al-Shāṭir, $\delta\ (\alpha)$

Fig. 2. The lunar equations of Ibn al-Shāṭir: C_3, C_4, C_5, and Qazwīnī; E_1, E_2, E_3, and σ.

3. *Calculation of the Solar True Longitude*

The investigation below confines itself to the systems used for the two luminaries only, the sun and the moon. The methods applied to the latter resemble those for the other planets. In all cases the underlying models are non-Ptolemaic, having been worked out by Ibn al-Shāṭir. They have been adequately described in the reference already cited. Like Qazwīnī, we assume their definitions, considering only their reduction to numerical results.

The solar longitude is

$$\lambda = \lambda_a + \alpha + \delta(\alpha), \qquad (1)$$

where λ_a is the apsidal longitude, and α is the mean longitude measured from the apogee. Both are linear functions of time, and for any desired instant are formed by adding properly chosen entries from the mean motion tables.

The only difficulty is offered by δ, the "equation" (*taᶜdīl)*. Ibn al-Shāṭir's δ is shown as the lower curve of Figure 1, and selected values from a copy of his *al-zīj al-jadīd* (Bodleian Ms. Seld. A. inf. 30, f. 31v) have been transcribed in Column II of Table 1 below. Note that for half the span the function is negative, necessitating a subtraction rather than an addition. Moreover, should the argument, α, turn out to be non-integer, a linear interpolation would be called for. However trivial, this involves multiplication and division.

Qazwīnī got around these difficulties by using two expedients. He eliminated the subtraction by adding a constant to Ibn al-Shāṭir's δ sufficiently large to make the resulting function everywhere positive. Thus Qazwīnī's solar equation table is

$$e = \delta + 2;3,0^{0} \ .$$

The resulting function is shown as the upper curve of Figure 1, and values corresponding to those of Ibn al-Shāṭir have been transcribed to Columns III and VI of Table 1. To check the precision of these values a program was written and run at the Harvard University computer center to recalculate Qazwīnī's table of $e(\alpha)$ using Ibn al-Shāṭir's parameters. The results have been excerpted in Columns IV and VII of the same table. Differences between corresponding pairs of values rarely exceed four seconds of arc.

To compensate for the constant by which the equation was increased, the same number was subtracted from the mean longitude at epoch so as to yield the same true longitude as expression (1). That is

$$\lambda = \lambda_a - 2;3,0^{0} + \alpha + e(\alpha)$$

This procedure was a stock device in astronomical computation, appearing already in the ninth century.[18]

18. E. S. Kennedy and Hala Salam, "Solar and Lunar Tables in Early Islamic Astronomy", *Journal of the American Oriental Society*, 87 (1967), 492-497.

Such work was indeed carried through in the Middle Ages.[13] Rather, al-Qazwīnī was one of the last participants in a quite different tradition. Workers in this field, accepting the models as valid, set themselves the objective of converting the abstract machinery into numerical results. In particular, they sought to ease the task of the individual computing planetary positions to the extent that, ideally, the job became a sequence of

1. looking up values in numerical tables, and
2. adding pairs of numbers.

These activities are to be regarded as computational mathematics rather than astronomy. They were widespread in the medieval Middle East, and have been the subject of several studies in recent years.[14]

2. The Source

Our author's full name is ᶜAbd al-Raḥīm al-Qazwīnī, Ibn al-Mullā ᶜAbd al-Karīm al-shahīr bi al-ᶜAjamī, and his work here studied is called *Kitāb al-zīj fī al-falak* (The Book of the Tables of Astronomy). The copy used is Berlin Ms. 5762, described briefly by Ahlwardt[15] and mentioned by Brockelmann.[16] The little that is known about Qazwīnī's life has been inferred from his writings. Ẓāhiriyya Ms. Falak 10378, containing prayer tables, states that, like Ibn al-Shāṭir three centuries before him he was a muwaqqit (time keeper) at the Umayyad mosque in Damascus. The year 1019 A. H. (=1610 A.D.) fixing his lifetime is the epoch of his planetary tables (*K. al-zīj*, f. 19v), and this is confirmed by a marginal note (f. 14r) stating that the author calculated the longitude of the fixed stars as of 1020 A.H. He composed at least two other astronomical treatises, both using the models of Ibn al-Shāṭir. Their names are given (f. 1r, *K. al-zīj*) as (1) *al-ḥabtaq fī al-taqwīm al-muṭlaq* (= *al-ḥabtaq* for planetary positions) and (2) *al-rawḍ al-zāhir bi-ḥall wa'ikhtiṣār zīj ibn al-Shāṭir* (lit. the flower garden, which is the solution and the summary of the *zīj* of Ibn al-Shāṭir).[17] Dr. David King states that the Cairo Ms. attributed by Brockelmann[16] to Qazwīnī is in fact not by him.

13. For examples, see A. Sabra and N. Shehabi, Ibn al-Haytham: *Al-shukūk ᶜala Baṭlamyūs* (Cairo, 1971); Ibn al-Shāṭir, *Nihāyat al-Sūl* (unpublished English translation by Victor Roberts, the papers of Hartner cited above, and E. S. Kennedy and I. Ghanem, *The Life and Work of Ibn al-Shāṭir*, Aleppo,1976).

14. See, e.g., M. Tichenor, "Late Medieval Two-Argument Tables for Planetary Longitudes", *Journal of Near Eastern Studies*, 26 (1967), 126-128; Jensen, op. cit.; G. Saliba, "The Double-Argument Lunar Tables of Cyriacus", *Journal for the History of Astronomy*, 7 (1976), 41-46; O. Neugebauer, "Studies in Byzantine Astronomical Terminology", *Transactions of the American Philosophical Society*, N.S. 50 (1960), 1-45.

15. W. Ahlwardt, *Verzeichnis der arab. Hss. der königlichen Bibliothek zu Berlin*, Vol. 5 (Berlin, 1893). Dr. D. King brings to my attention another incomplete copy of this work, mis-catalogued at the Ẓāhiriyyah library in Damascus, which I have not yet seen.

16. C. Brockelmann, *Geschichte der arabischen Literatur* (Leiden, 1943), vol. II, p. 413. Brockelmann does not mention the other two works of this author, kept in Princeton Yehuda 3152 and Ẓāhiriyyah Falak 10378.

17 Titles such as *ᶜāṭir* or *zāhir* that rhyme with Shāṭir were numerous as shown by King, *DSB*, *op. cit.*, which attests to the influence and popularity of Ibn al-Shāṭir.

Computational Techniques in a Set of Late Medieval Astronomical Tables

George Saliba*

1. *Introduction*

It is a commonly held opinion that the decline of Islamic science coincided with the rise of al-Ghazzālī in the early twelfth century. This notion can be maintained only at the risk of neglecting the important work of such people as Naṣīr al-Dīn al-Ṭūsī (d.1274 A.D.)[1], Ibn Maḥfūẓ al-Baghdādī (fl. ca. 1295)[2], Quṭb al-Dīn al-Shīrāzī (d. 1311)[3], Ibn al-Shāṭir (d. ca. 1375)[4], Qāḍī Zāda al-Rūmī (ca. 1436)[5], Jamshīd Ghiyāth al-Dīn al-Kāshī (d. 1429)[6], and Ulugh Beg (ca. 1440)[7], to name only some major figures and only in the East. Less well-known individuals are Ibn al-Majdī[8] and Shams al-Dīn al-Ṣūfī[9], both of fifteenth century Egypt, and ᶜAbd al-Raḥmān al Ṣāliḥī (15-16 th centuries)[10], Ibn Zurayq (fl. ca. 1400), Ibn al-Kayyāl (fl. ca. 1550)[11], al-Nābulsī (fl. ca. 1590)[12], and ᶜAbd al-Raḥīm al-Qazwīnī (fl. ca. 1610), all working in Damascus.

This paper elucidates some aspects in the work of the savant last named above. It is also a contribution in support of the claim that Islamic astronomy, if not science generally, retained its vigour well beyond the time of al-Ghazzālī, down through the seventeenth century.

The material to be described does not involve reform or improvements in the abstract models used to describe the motions of the heavenly bodies.

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1. H. Suter, *Die Matematiker und Astronomen der Araber und ihre Werke* (Zurich 1900), No. 368. The main works discussing the contributions of Ṭūsī are now listed in the short biography in the *Dictionary of Scientific Biography* (New York, abbreviated hereafter *DSB*). Add the two important articles by Willy Hartner: "Naṣīr al-Dīn al-Ṭūsī's Lunar Theory", *Physis* 11 (1969), 287-304, and "Copernicus, the Man, the Work, and its History", *Proceedings of the American Philosophical Society*, 117 (1973), 413-422.

2. Claus Jensen, "The Lunar Theories of al-Baghdādī", *Archive for History of Exact Sciences*, 8 (1972), 321-328, and Suter, No. 490.

3. S. H. Nasr, *DSB*, *s.v.* Quṭb al-Dīn al-Shīrāzī.

4. D. King, *DSB*, *s.v.* Ibn al-Shāṭir, esp. the bibliography section which updates the literature on Ibn al-Shāṭir.

5. H. Dilgan, *DSB*, *s.v.* Qāḍī Zāda al-Rūmī.

6. A. P. Youschkevitch & B. A. Rosenfeld, *DSB*, *s.v.* al-Kāshī, with excellent bibliography.

7. T. N. Kari-Niazov, *DSB*, *s.v.* Ulugh Beg.

8. D. King, "A Double Argument Table for the Lunar Equation Attributed to Ibn Yūnus", *Centaurus*, 18 (1974), 129-146, esp. p. 131.

9. *Ibid.*

10. D. King, *DSB*, op. *cit.*

11. *Ibid.*

12. *Ibid.*

4. Kennedy, E. S., "A Survey of Islamic Astronomical Tables", *Transactions of the American Philosophical Society*, N.S. 46, Pt. 2, Philadelphia, 1956.

5. Kennedy, E. S., and Hamadanizadeh, Javad, "Applied Mathematics in Eleventh-Century Iran: Abu Jaᶜfar's Determination of the Solar Parameters", *The Mathematics Teacher*, 58 (1965), 441-446.

6. Neugebauer, O., *The Exact Sciences in Antiquity*, 2d, ed., Providence, 1957. There exist paperback printings by Harper, 1962, and by Dover, 1962.

7. Salam, Hala, and Kennedy, E.S., "Solar and Lunar Tables in Early Islamic Astronomy", *Journal of the American Oriental Society*, vol. 87 (1967), p.p. 492-497.

8. Sayili, A., *The Observatory in Islam*, Türk Tarih Kurumu Basimevi, Ankara, 1960.

9. Suter, H., "Die Mathematiker und Astronomen der Araber und ihre Werke", *Abhandlungen zur Geschichte der mathematischen Wissenschaften* .... X Heft, Leipzig, 1900.

In order to show the degree to which Ibn al-Aᶜlam was an innovator, the first and second columns of the table give respectively the maximum equations of Ptolemy's Almagest, the greatest work of ancient and medieval astronomy, and al-Battānī [1], Ibn al-Aᶜlam's able predecessor. Out of the total of thirteen parameters in the table, Ibn al-Aᶜlam has altered seven from the Ptolemaic values. The apparent increase of two minutes in the epicyclic equation of Mercury does not imply an increase in the underlying function – the table in which it occurs has been calculated with values more closely spaced than in the Almagest, hence the table maximum is slightly closer to the maximum of the function.

The change in the solar equation is not surprising, and may well be based upon observations. The technique for deriving the sun's parameters is straightforward, and was applied by several Islamic astronomers, e.g. Abū Jaᶜfar in [5].

What is unique is the large number of alterations in the planetary equations. Almost all medieval astronomers took over the Ptolemaic values without question. No explanation is available giving Ibn al-Aᶜlam's reasons for the changes he effected, and according to al-Bīrūnī (in [2], p. 35) no explanation was ever written.

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corresponding entry in Table 3. This is sufficient, however, to verify the statement of Ibn Yūnus (in [3], p. 168) that Ibn al-Aᶜlam's apsidal motion amounts to one degree in seventy years (Persian years of 365 days each). For $0;0,0,8,28 \times 365 \times 70 = 0;0,0,8,28 \times 6,5 \times 1,10 = 1;0,5,23,20$.

7. *Planetary Equations*

With the single exception noted below, we do not possess any equation tables from the Ibn al-Aᶜlam zīj. Since, however, several sources make it possible to assemble a reliable set of maximum equations, and since the model is Ptolemaic, it would be no great job to write a computer program to print out a complete set of Ibn al-Aᶜlam's equation tables. The maxima are shown below in the third and fourth columns of Table 4. In general there is a pair of entries for each planet, the first being the deferent equation (equation of the center) the second the epicyclic equation.

With the single exception discussed in the next paragraph, those obtained from the Ashrafī Zīj [H], in the third column, are all from tables (ff. 234-237). Hence the probability of scribal errors is nil, for the maxima have been picked from a whole range of nearby entries in each table. The values in the fourth column, inferred from remarks in Bīrūnī's "Transits" ([2], pp.26, 27, 35, 136, 147), are less secure. Generally speaking they are the same as, or very close to, the corresponding entries in the third column.

On f.229v the Ashrafī text states that in the Sanjarī zīj (No.27 in[4]) Ibn al-Aᶜlam's maximum lunar equation is $4;51^0$, so in calculating lunar true longitudes the table of al-Battānī may be used. But the corresponding parameter in al-Battānī's zīj is $5;1^0$ ([1], vol. ii, p. 80). Moreover, we have found no such statement in the Vatican copy, MS Arabo 761, of the Sanjarī Zīj. We are unable to resolve this difficulty.

	The Almagest	Battānī [1]	Ibn al-Aᶜlam	
			from the Ashrafī Zīj	from Bīrūnī's "Transits"
Sun	$2;23^0$	$1;59,10^0$	$2;0,10^0$	$2;0,10^0$
Moon	5;1 13;9	5;1 13;9	4;51 13;9	4;53
Saturn	6;31 6;13	6;31 6;13	5;48 6;13	5;43
Jupiter	5;15 11;3	5;15 11;3	5;32 11;3	5;33
Mars	11;25 41;9	11;25 41;9	11;25 42;9	11;25
Venus	2;24 45;57	1;59 45;59	1;59 45;59	2;0
Mercury	3;2 22;2	3;2 22;2	3;40 22;22	3;40

Table 4. Maximum Planetary Equations

Planet	Degrees per day
sun	0;59,8,19,46,42
moon	13;10,35,2,1
lunar anomaly	13;3,53,56,12
lunar nodes	– 0;3,10,41,9
Saturn	0;2,0,35,28
Jupiter	0;4,59,16,23
Mars	0;31,26,39,36
anomaly of Venus	0;36,59,28,12,19
anomaly of Mercury	3;6,24,7,14
(apsidal motion)	0;0,0,8,28

Table 3. Planetary Mean Motions in Ibn al-Aᶜlam's Zīj

The mean rate of Jupiter is the same as that used in the Īlkhānī Zīj (No. 6) and the Khāqānī Zīj (No. 20).

For Mars also the rate shown is the same as that of the Īlkhānī and Khāqānī Zījes, and additionally the Escorial version of the Mumtaḥan Zīj (No. 51). This parameter is confirmed independently by a table in the Baghdādī Zīj ([D], ff. 85v, 86v) of mean motions for Mars specifically attributed to Ibn al-Aᶜlam. The Mars parameter given in our Table 3 does not occur as such in the Baghdādī Zīj table, but it has been shown to underly it by a process of "squeezing" the tabular entries.

Dr. David King pointed out that f. 43r of the Muṣṭalaḥ Zīj [F] is a table of the mean "center" (longitude measured from apogee) of Mars according to the doctrine of Ibn al-Aᶜlam. Squeezing of this table leads to a total motion of 1,32,50;59,17° for Mars' center in a 30-year Hijra cycle. This number is secure, for its residue modulo 360° is given, ascribed to Ibn al-Aᶜlam, on f.92r, a page of incidental astronomical parameters, in [E]. Division of this number by the number of days in the cycle yields 0;31,26,30,59,26° for the daily motion of the center. If the daily apsidal motion is added to this, there results the mean motion, 0;31,26,39,27°. This is reasonably close to the entry for Mars in Table 3, considering the imprecision of the apsidal motion, discussed below.

Again, the anomalistic motion of Venus is very close to the analogous parameter in the Īlkhānī and Khāqānī zījes.

The apsidal (or precessional) motion is so slow that even in a span of twenty years its travel in degrees involves only two sexagesimal digits. For this reason, only the two significant digits shown can be relied upon in the

According to Islamic doctrine, the apogees are fixed in the celestial sphere, hence their longitudes increase with precession. If this was the case with Ibn al-Aᶜlam, and if none of the reported values were corrupt, there should be a constant difference between corresponding elements of any two sets of apogees. The last three columns of Table 2 give the three sets of such differences between the three pairs of apogee sets.

As remarked in Section 6 below, Ibn al-Aᶜlam gave the apogees a motion of one degree in seventy years. The time elapsed between the dates assigned to columns (3) and (1) is $1303-632=671$ years. Hence the motion in this time is about $671/70=9:35^0$. The entries in column (6) do not differ far from this number. However, they are not all the same. The situation in column 5 is much worse. Now the elapsed time is $1303-1211=92$ years, and $92/70 \approx 1;19$. None of the entries in (5) equal this, and some are far off indeed. In column (4) also the entries for Jupiter and Mercury vary drastically from the other elements in the column. At the same time, the common terminal digit of 51 in column (1) and 19 in column (3) indicate a uniform precessional correction added at some time. Evidently some of the apsidal longitudes have been garbled in transmission, the set in column (2) being particularly bad. Nevertheless they are worth passing on, against the possibility of better copies turning up.

6. *Mean Motions*

On f.234r of the Ashrafī Zīj [H] is a table giving, to seconds of arc, the motion in twenty years of each of the planets according to each of eleven zījes. Five of these are extant, hence their mean motion parameters are at hand and provide ample control of techniques for extracting the corresponding parameters for the six zījes which are not available.

In fact, although the text says "Jalālī" years, it can be shown that what is intended is Julian years of 365¼ days each. Twenty of these years contain 2,1,45 days, so all that is needed is to divide this number into each of the text numbers after having added the requisite multiples of 360^0 to each of the latter. The quotients are mean angular velocities in degrees per day.

For our author the results are tabulated in Table 3 (p. 21).

The value for the solar motion is very close to the 0;59,8,19,46,51, calculated from a number given by Ibn Yūnus in [3], p. 154 (the Ḥākimī Zīj No. 14 in [4]).

This lunar motion is that of the Sanjarī Zīj (No. 27), and close to that of the Riḍāʾī Zīj writen by Abū al-Ḥasan Yazdī.

The lunar anomalistic rate given here is that of the Sanjarī Zīj.

The rate of the lunar nodes is close to the value used by Ptolemy in the "Planetary Hypotheses".

The mean rate of Saturn is the same as that of Yazdī's Riḍāʾī Zīj, and is close to the rate used by Ibn Yūnus in the Ḥākimī Zīj, No. 14.

Planet	Dastūr, (G) Yazdigird Era	Check	Ashrafī, (H) 13 March 1303
mean sun	87;46,53°	87;14,48°	11^s 27;58,41°
mean moon	4;39,26	66;41,36	9 11;9,44
lunar anomaly	29;17,45	291;58,35	9 12;49,17
lunar node	304;	298;12,22	2 18;20,8
mean Saturn	239;24	224;20,6	5 0;47,41
mean Jupiter	271;33	254;38,54	3 10;45,42
mean Mars	332;46,47	311;1,8	4 2;54,1
Venus, anomaly	122;11,52	122;21,47	10 21;37,5
Mercury, anomaly	illegible		8 7;41,19

Table 1. Mean Positions at Two Dates

The elapsed time between the two epochs expressed in sexagesimals, is 1,8,3,7 days. This number was multiplied by each of the mean motions in degrees per day displayed in Table 4 below. The resulting products were subtracted from the corresponding entries in the third column and the resulting differences entered in the second column. When they are compared with the corresponding entries in the first column it is seen that at least two pairs are hopelessly divergent, and only the anomalies of Venus show good agreement.

The same two sources (on ff. 2r and 232 v respectively) give apsidal longitudes at the same two dates. They have been transcribed, in zodiacal signs and degrees, in columns (1) and (3) of Table 2. A third set of apogees, found in source [B] by Dr. David King, is given in column (2). They are said to be for the (beginning) of year 580 of Yazdigird, which corresponds to 23 January, 1211.

Planet	(1) Dastūr [G] Yazdigird Era 16 June, 632	(2) [B] 23 Jan., 1211	(3) Ashrafī [H] 13 March, 1303	(4) =(2)−(1)	(5) =(3)−(2)	(6) =(3)−(1)
the sun	2^s 19;30°	2^s 28;9°	2^s 29;5,19°	8;39°	0;56,19	9;35,19
Saturn	8 7;5,51	8 15;44	8 16;[55],19	8;38,9	1;11,19	9;49,28
Jupiter	5 21;4,[51]	5 19;43	6 0;57,19	−1;21,51	11;14,19	9;52,28
Mars	4 6;15,51	4 14;56	4 16;5,[19]	8;40,9	1;9,19	9;49,28
Venus	2 6;4,51	2 15	2 15;55,19	8;55,9	0;55,19	9;50,28
Mercury	7 7;2,51	7 26;32	7 16;55,19	19;29,9	−9;36,41	9;52,28

Table 2. Planetary Apogees According to Ibn al-Aᶜlam

see [4], p. 134), Kūshyār b. Labbān (fl. 1010, see [4], p. 125), and Farīd al-Dīn ^{c}Alī al-Bakū'ī ([4], p. 128).

As for Ibn al-A^{c}lam, we cannot say whether the tables in his zīj were of the original or the displaced type, but the probability inclines toward the former. At the top of f. 37v of [C] is an Arabic title translated as "A Table of the Equation(s) of Mars – Observation of the Sharīf Ibn al-A^{c}lam". The entries in the table are, by and large, identical with those of the corresponding table in al-Battānī's zīj, which are of the original, not the displaced variety. It seems probable that this was copied from the zīj of Ibn al-A^{c}lam. Of course the implication in the title that the table is based upon observations by Ibn al-A^{c}lam is absurd – the parameters are Ptolemaic. Dr. David King informs us that the same table (except for scribal variants), also attributed to Ibn al-A^{c}lam, appears on ff. 43v-44v of [F].

It is true that two of the equation tables in the appendix of the Ashrafī Zīj for calculating true longitudes according to the doctrine of Ibn al-A^{c}lam, are of the displaced type. These are for the first equation of Saturn (f. 234 v) and the first equation of Jupiter (f. 235v). On the other hand, the same appendix (at ff. 236v-237v) gives a complete set of equation tables for the sun and for Mercury, incorporating Ibn al-A^{c}lam's parameters, and they are of the original, not the displaced type.

At another place (f. 239r) in the Ashrafī appendix a page is entitled "Table of the Solar Equation According to the Battānī Displaced *(waḍ^{c}ī)* Zīj". The table is indeed of the type indicated, whereas none of the tables in the published version of al-Battānī's zīj, [1] are of this kind. Hence we infer that recensions of popular zījes were sometimes made in which the tables were converted from the original into the displaced form.

5. *Epoch Mean Positions*

To calculate planetary true positions, three determinations are necessary. First, one notes the mean position at a particular epoch. Second, by using the mean motion tables, obtain the mean angular distance the object has travelled from epoch to the time in question (dropping complete revolutions). Third, use the equation tables to calculate the correction converting from mean to true position. Ibn al-A^{c}lam's material on each of these three topics is discussed in this and the last two sections respectively.

Table I below shows two sets of mean positions. In the first column are the values for Ibn al-A^{c}lam (given together with those of several other zījes) on f. 2v of the Dastūr [G] for the epoch of Yazdigird, 16 June, 632 A.D. The third column, the entries being in zodiacal signs and degrees, is from f.231v of [H] the Ashrafī zīj. The epoch of Ibn al-A^{c}lam's zīj is presently unknown.

In the main expression,

$$\Lambda = \lambda_0 + \alpha' - k_3 + c_6(\gamma') + k_3 + c_8(\alpha' - k_3 + k_3) \cdot \left\{ \begin{array}{l} c_5(\gamma'),\ c_8 \leqslant 0 \\ c_7(\gamma'),\ c_8 \geqslant 0 \end{array} \right\} = \lambda .$$

That is, provided the imposed conditions are satisfied, true longitudes calculated by this category of tables will be the same as those using the standard variety of tables.

For the planet Mars in the Ashrafī tables [H] the upward displacement of the first equation, $k_2 = 12^0$. That of the second equation, which is also the leftward displacement of c_8, the interpolation function, $k_3 = 48^0$. The leftward displacement of the first equation, $k_1 = 60^0$, so that the condition $k_1 = k_2 + k_3$ is indeed satisfied. This is the case also for the tables for other planets examined by us, although, of course, different k's are used for different planets.

In zījes in which this type of equation tables appears it is necessary that the mean motion tables be modified accordingly. The independent variables to be fed into (1) to obtain λ are α and γ tabulated among the mean motions. If (2) is used, the entries in the corresponding tables must be decreased by k_1 and increased by k_2 respectively.

4. *Purpose and History of the "Displaced" Tables*

In the medieval literature, tables of the type used in (1) are said to be *aṣlī* (original), whereas the transformed variety appearing in (2) (which we designate with capital letters) are called *waḍ*^{c}*ī* (relating to position, positivistic, etc.) which we call "displaced." Evidently the reason for working them out was to ease the task of the astronomer or astrologer who calculates planetary positions for almanacs or horoscopes. In (1) the first and second equations, c'_3 and c_6, take on (as we would put it) both negative and positive values. The medieval user of (1), not having the concept of negative numbers at his disposal, must continually bear in mind a complicated set of rules as to when a particular term is to be added and when subtracted. Expression (2) is easier to use because in it C'_3 and C_6 are always positive. By no means does the use of (2) eliminate all subtractions, since c_5, c_7, and C_8 still take on negative values, but there are fewer than with (1). The displaced tables are typical of a pervasive tendency in Islamic science to provide extensive and elegant numerical tables for the convenience of practitioners. The underlying astronomical theory is neither questioned nor affected.

The techniques sketched here were already being used in ^{c}Abbasid times. The lunar equation tables in the zījes of Ḥabash al-Ḥāsib (fl. 850, see [4], p. 126), are of the displaced type. They are described in [7]. The author of the Ashrafī Zīj ([H], f. 48) has a long discussion of variant approaches in the manipulation of planetary equations. With each technique he associates an originator, naming, e.g. the well-known Abū al-Wafā$^\text{ɔ}$ al-Buzjānī (fl. 970,

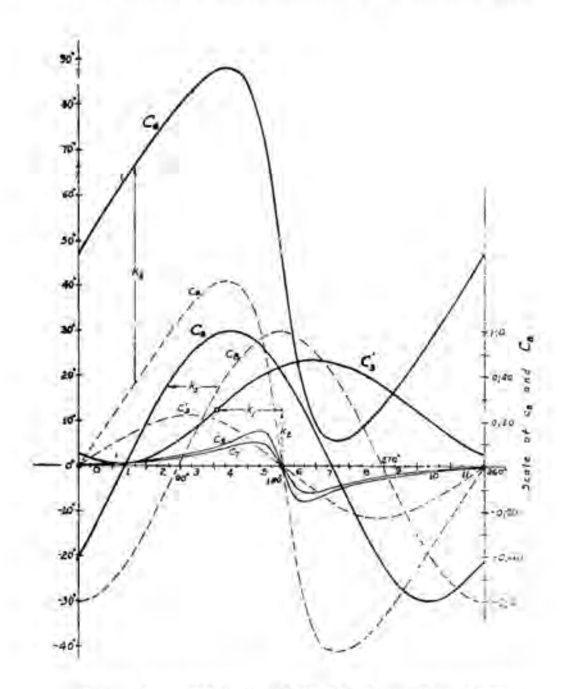


Figure 1. — Original and displaced equations of Mars.

Finally, a horizontal translation of the interpolation function c_8 by the distance k_3 to the left carries it into C_8. I.e., $C_8(x) = c_8(x+k_3)$.

To calculate a true longitude by using tables of this sort, form

$$\Lambda = \lambda_0 + A' + C_6(\Gamma') + C_8(A') \cdot \begin{cases} c_5(\Gamma'), & C_8 \leqslant 0, \\ c_7(\Gamma'), & C_8 \geqslant 0, \end{cases} \tag{2}$$

where $A = \alpha - k_1$, $\Gamma = \gamma + k_2$, $A' = A + C'_3(\mathrm{A})$, $\Gamma' = \Gamma - C'_3(\mathrm{A})$.

We proceed to express (2) in terms of the lower case symbols rather than the capitals which appear, making use of the transformations already given and imposing additionally the condition that $k_1 = k_2 + k_3$.

$$\begin{aligned} A' &= A + C'_3(A) = A - c'_3(A+k_1) + k_2 = \alpha - k_1 - c'_3(\alpha - k_1 + k_1) + k_2 \\ &= \alpha - c'_3(\alpha) + k_2 - k_1 = \alpha' - k_3 . \end{aligned}$$

$$\begin{aligned} \Gamma' &= \Gamma - C'_3(A) = \Gamma - (-c_3(A+k_1) + k_2 = \gamma + k_2 + c_3(\alpha - k_1 + k_1) - k_2 \\ &= \gamma + c_3(\alpha) = \gamma' . \end{aligned}$$

When numbers are represented in sexagesimals in the sequel the now standard convention is applied whereby digits are separated by commas, and the "sexagesimal point" is represented by a semicolon.

2. *Ptolemaic Planetary Equation Tables*

In the Almagest, and in the large number of astronomical tables modeled directly upon it, planetary true longitudes are calculated by applying the expression

$$(1) \qquad \lambda = \lambda_0 + \alpha' + c_6(\gamma') + c_8(\alpha') \cdot \begin{cases} c_5(\gamma'), & c_8 \leqslant 0, \\ c_7(\gamma'), & c_8 \geqslant 0, \end{cases}$$

where $\qquad \gamma' = \gamma + c'_3(\alpha), \quad$ and $\quad \alpha' = \alpha - c'_3(\alpha).$

λ_0 is the longitude of the planet's apogee; α is the "center" (Arabic *markaz*), the planet's mean longitude measured from the apogee; and γ is the argument of the epicyclic anomaly. All three of these variables are linear functions of time, and can be obtained from the mean motion tables of the zīj being used.

The function c'_3 is the equation of the center, the "first equation" of the Islamic literature; c_6 is the epicyclic equation, the "second equation," calculated for the epicycle at mean distance. The last term of (1) is a modification introduced to take account of the fact that in general the epicycle is not at mean distance. c_8 is an interpolation function varying between $+1$ and -1. c_5 and c_7 are, for fixed values of γ', the decreases and increases in c_6 engendered by shifting the epicycle from the mean to its greatest and least distances respectively.

Graphs of these functions for the planet Mars are shown on Figure 1; the configurations defining them are to be found in [6], pp. 198-202. There α' is not defined, and the argument of c_5 and c_7 is the unmodified α. But in the Ashrafī Zīj [H] the use of α' is explicit.

3. "*Displaced*" *Equation Tables*

In many zījes some of the functions tabulated for the calculation of planetary tables differ from those described above. As with the standard Ptolemaic tables there are five functions for each planet, and of these c_5 and c_7 reappear. The function analogous to c_6, the epicyclic equation, we call C_6. For the planet Mars it also has been plotted on Figure 1. It has the same shape as c_6, but has been displaced upwards a distance k_3 which has a different value for each planet. That is, for any x, $C_6(x) = c_6(x) + k_3$.

The function corresponding to c'_3 appears in the figure with the label C'_3. The elements of this pair of curves are also related, but in a more complicated fashion than c_6 and C_6. To transform c'_3 into C'_3, invert the former, then translate it upward a distance k_2 and to the left a distance k_1. In symbols, $C'_3(x) = -c'_3(x + k_1) + k_2$.

The Astronomical Tables of Ibn al-Aᶜlam

E. S. KENNEDY*

1. *Introduction*

In studying the history of medieval astronomy, some significance attaches to a category of documents called zījes. These are collections of numerical tables which made it possible for the possessor of one to solve the standard astronomical-astrological problems of his time. The total number of such handbooks produced from the eighth through the fifteenth centuries amounted to something over a hundred and fifty, of which perhaps half are extant. Among the zījes which seem to have disappeared is the one known variously as the Zīj al-Sharīf, al-Zīj al-ᶜAḍudī, and ambiguously, as al-Zīj al-Baghdādī. It has been given the number 70 in the list in [4], now badly out of date. (References in square brackets are to the bibliography at the end of the paper).

Its author was one ᶜAlī b. al-Ḥusayn abū al-Qāsim al-ᶜAlawī, Ibn al-Aᶜlam, al-Sharīf al-Ḥusaynī, d. 985. From the title last named came one of the apellations of his zīj. From ᶜAḍud al-Dawla, Buwayhid dynast and the author's patron is the second, and from his place of residence the third. (See [9], p. 62; [8], pp. 106-8.)

Ibn al-Aᶜlam's work commanded great respect, particularly because of his observations. The literature of his time and later contains numerous references to him. The object of this paper is, by studying these references, to form as complete a notion as possible of the contents of his lost zīj. In order to do this it has been necessary first to explain certain variant forms of planetary tables widely used in the Middle Ages. Worked out by several Muslim astronomers, they were based on Ptolemaic theory, but better adapted to quick computation than those in the direct Almagest tradition. The explanation takes up Sections 2, 3, and 4 below. It is assumed that the reader is conversant with the Ptolemaic planetary models as described in, say, the first appendix of [6]. In particular we have taken over the notation there used by Neugebauer.

The concluding three sections present Ibn al-Aᶜlam's planetary parameters: epoch positions, mean motions, and equations respectively. A corollary of the investigation is the validity of Wābkanwī's allegation (in [A], f. 3r) that the famous Naṣīr al-Dīn al-Ṭūsī did not apply his own observations in the Īlkhānī Zīj, but took over and used mean motions of Ibn al-Aᶜlam.

Most zījes contain material on calendars, tables of trigonometric and spherical astronomical functions, geographical tables, and tables of fixed stars. No information is available on such things in Ibn al-Aᶜlam's zīj.

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the Persians; the direction and division came in that year to the twentieth degree of Pisces[9]. And 10 years after this shift, that is, in the year 3681[10] of the Flood, there had elapsed 11 periods from the period which began 279 years before the Flood. This is the revolution of the year of the Blessed One[11], namely of the period in which we are.

And there was the completion of 12[12] periods from the period which began 279 years before the Flood — at the completion, namely, of the solar year 4041[13] of the Flood — at 2 and 5/6 hours and a fifth of 1/6 of an hour at the city Arin[14] on the Saturday which was 9 Jumādā II (namely the sixth lunar month) in the year 328 of the Arabs, which was 21 March[15] in the year 1251 of Alexander; and it was <27> Isfandārmudh (which is the twelfth[16] month of the Persians) in the year 308[17] of king Yazdijird[18]. The ascendent and the planets were equated by means of the *Zīj*, that is, the *Book of motions*, of al-Khwārizmī[19] according to the master of the Indians at the center of the world[20]; at the city Corduba they are 10 and 2/3 hours of the night[21] of the afore-mentioned Saturday[22]. The lord of the period from among the signs was Cancer, the lord from among the planets Mercury; the degree to which the direction had come was the first degree of Aries, and the divisor was Jupiter[23].

The[24] *Liber universus* of ᶜUmar ibn al-Farrukhān al-Ṭabarī[25] is completed, with the praise of God and His aid, which master John of Seville and Luna translated from Arabic into Latin."

9. This agrees with Māshā'allāh's statement (*The Astrological History*, p. 48).

10. 3682 *D*.

11. Benedicti *H*, habenda *D*. The Blessed One is, of course, Muḥammad, who was born, according to Māshā'allāh (*The Astrological History*, p. 127), on 7 February 572; but the astrological history in Berlin Arab 5900 (*The Thousands*, p. 69) also connects the birth of the Chosen One (Muḥammad) with the Fardār of Venus and Gemini.

12. 11 *D*.

13. 4021 *D*, 4091 *H*.

14. Arim *H*. ارين is a simple corruption of اوزين or Ūzayn = Ujjayinī.

15. Maii *H*.

16. 11 *D*.

17. 369 *D*.

18. Iazdagird *H*, ierdagird *D*.

19. Alchoarizam *H*, algehar *D*.

20. For medius mundus see *The Thousands*, p. 45.

21. noctis *om*. *D*.

22. The time-difference of 2:52 A.M. minus 10:40 P.M. or 4:12 hours between Baghdad and Corduba is that used by al-Majrīṭī (see O. Neugebauer, *The Astronomical Tables of al-Khwārizmī*, Kobenhavn 1962, pp. 110-111).

23. The divisor (قاسم) is the lord of the term in which the division falls (*The Thousands*, p. 63); the first term of Aries is ruled by Jupiter.

24. The colophon is omitted by *H*.

25. Aomar Benigaii Tyberiadis *D*.

APPENDIX

This translation of the *Liber universus* is based on the printed edition (*H*) and the Digby manuscript (*D*). Only the more significant variants are noted.

"Kanaka[1] the Indian said that the beginning of the period (orbis[2]) was 279 years before the Thursday which was the beginning of the years of the Flood; and that Saturn and Cancer ruled that period; and that at the beginning of that period the division[3] and the direction[4] had come to the first degree of Aries.

Therefore, if you wish to know when this period is completed, take the years of the Flood and add 279 to them. Whatever should be the sum, cast out by 360, that is, divide by 360. If the number should be used up, the period is already completed; and if something should remain, they will be the years to come of the period which is not yet finished. While you cast out by 360, know how many times you have cast out this number. Cast out one zodiacal sign for each time, and begin from Cancer; in whichever sign the number should be used up, that sign will be the lord of the period. If you should cast out a planet for each time and begin from Saturn, that planet to which the casting out should come will be the lord of the period. If you should take the years of the Flood, add to them 279, cast out the periods (that is, divide them by 360), and a number should remain for you, cast that number out from the beginning of Aries at the rate of one degree per year. The degree to which the number should come out of (all) the degrees is the very degree to which the direction and division shall have come.

Know that 3671[5] solar years elapsed from the Flood until the conjunction shifted from the airy signs to the watery signs, that is, in Scorpio, and this was 61[6] years 3 months 15 days and 12 and 1/3 hours[7] before Yazdijird[8], the king of

1. Kankaraf *N*, Vakal *D*.
2. Orbis = فردار
3. Divisio = قسمة
4. Directio = انتهاء
5. 3682 *D*. The date of the mean conjunction of Jupiter and Saturn in Scorpio at the required shift was 12 December 570; see *The Astrological History*, p. 98. But the significant vernal equinox was taken to be that of 19 March 571.
6. 60 *H*.
7. Māshā'allāh gives the interval as 61 years 2 months 17 days and 16 hours (*The Astrological History*, p. 48), to which must be added 5 epagomenal days (*ibid.*, p. 100); but his computation is wrong. The interval from 19 March 571 till 16 June 632 includes 61 Julian years and 90 days or 61 Persian years and 105 days; and 105 days equal 3 Persian months and 15 days. The remaining 12:20 hours represent the time-difference between the computed hour of the vernal equinox on 19 March 571 and the hour at which the era of Yazdijird III began.
8. Iazdagird *H*, redargui *D*.

For Heller's edition of al-Jahānī begins the addition (the *Liber universus)* with the words: *Dixit Kankaraf Indus*, which imply the Arabic : قال كنكه رب الهند . But the Digby manuscript begins: *Dixit Vakal Indus*, which suggests : قال : وقال الهند . Since Kanaka the Indian was apparently in Baghdad contemporaneously with ʿUmar and Māshā'allāh, and was interested in astrological history, I am inclined to accept the reconstruction of the Arabic original supported by Heller's text. Then ʿUmar's little treatise (assuming that it really is his) began with a paragraph citing Kanaka's opinion; this was followed by a second paragraph spelling out the practical computations that result. The third paragraph gives chronological data relevant to the birth of Muḥammad and to the commencement, in 580 A. D., of the Mighty Fardār current during ʿUmar's lifetime; most of the material in this third paragraph is found also in Māshā'allāh's كتاب في القرانات written in about 810 A.D.[18]

But the last paragraph gives as the date of the commencement of the current Mighty Fardār Saturday 9 Jumādā II, 328 A.H. = 21 March 1251 A. A. (Seleucid Era) = <27> Isfandārmudh 308 A.Y. at 2:52 A.M. at Ujjayinī (really Baghdad), which was 10:40 P.M. (Friday evening) at Corduba; this date corresponds to Friday/Saturday 20/21 March 940 A. D., which does indeed mark the commencement of a new Mighty Fardār. The text also refers to a horoscope for that time (not given in John's translation) cast by means of the *Zīj* of al-Khwārizmī according to the master of the Indians[19], and it has utilized the time-difference between Baghdad and Corduba that appears in al-Majrīṭī's revision of that *Zīj*. The text of ʿUmar's *Liber universus* that John of Seville translated in ca. 1125-1140 A.D., therefore, had been revised by someone able to use the version of al-Khwārizmī's *Zīj* made by al-Majrīṭī towards the end of the tenth century.

Thus an examination of the history of the *Liber universus* has allowed us to establish the true extent of ʿUmar's *De nativitatibus* while casting into doubt the identity of its Latin translator; to suggest that Kanaka the Indian described the Mighty Fardārs and their relation to the epoch of the Flood/ Kaliyuga before either ʿUmar or Māshā'allāh — that is, probably in the 790's; and to remove al-Jahānī from any further implication in this particular astrological doctrine.

18. *The Astrological History*, p. 113. On Māshā'allāh see further D. Pingree, *DSB* 9, New York 1974, pp. 159-162.

19. For the Indian origin of al-Khwārizmī's *Zīj* see now D. Pingree, "The Indian and Pseodo-Indian Passages in Greek and Latin Astronomical and Astrological Texts," *Viator* 7 (1976), 141-195, esp. 151-169.

based as they are on Ptolemy, Dorotheus, and Māshā'allāh, fits in admirably with what one expects from the pen of ʿUmar al-Ṭabarī.

There are also at least 16 manuscripts of the *De nativitatibus*[8], of which the earliest are of the thirteenth century. In some of these manuscripts[9] it is followed by a *Liber universus* also ascribed to ʿUmar and definitely translated by John of Seville; it is the colophon to this work that has led scholars beginning with the author of the catalogue cited in footnote 3 to attribute the translation of the *De nativitatibus* also to John. In fact, the *Liber universus* is quoted as a part of the *De nativitatibus* by the author of a text written in about 1351 and preserved in an Erfurt manuscript[10] and by the author of another text written at Newminster in 1428.[11]

The *Liber universus* contains a discussion of the Mighty Fardārs or periods of 360 years, whose epoch was 11 February -3380 or 279 years before the Flood — that is, before the Indian Kaliyuga which began at midnight of 17/18 February -3101[12]. The Mighty Fardārs are ruled by successive signs (beginning with Cancer) and planets (beginning with Saturn). Concurrently a Qisma and Intihā' rotate at the rate of 1^{0} per year; they start at Aries 0^{0} in -3380[13].

The *Liber universus* in John's translation was also appended, without the colophon, to the translation by Gerard of Cremona of the *De diversarum gentium eris, annis ac mensibus, et de reliquis astronomiae principiis* of al-Jahānī (al-Jayyānī)[14] which was published by Joachim Heller[15]. Since al-Jahānī wrote in Arabic in the second half of the eleventh century, he could not have included the Latin version of ʿUmar's work in his book; and I[16] and others[17] have been wrong in assigning to him the reference therein to Kanaka (Kanka) the Indian.

8. Carmody lists 17 manuscripts, of which two (Vat. Pal. 1363 and Vienna 10745) seem to be of other works, while he has missed Venice Marciana 343 ff. 131-134 (Thorndike, 33).

9. Thus Madrid BN 10053 of the thirteenth century on f. 141v (the explicit of the *De nativitatibus* is on f.141) (see J. M. Millás Vallicrosa, *Las traducciones orientales en los manuscritos de la Biblioteca Catedral de Toledo*, Madrid 1942, pp. 200-201); Dijon 1045 of the fifteenth century on f. 71v (see *Catalogue général des manuscrits, Départements*, vol. 5, Paris 1889, p. 270); and Oxford Digby 194 (ff. 96v-98 were copied by T. Brown at Bruges on 31 August 1425) on f. 127v (formerly f. 147v).

10. Edited in E. S. Kennedy and D. Pingree, *The Astrological History of Māshā'allāh*, Cambridge, Mass. 1971, p. 188.

11. Ibid., p. 191. The conjunction that the author there claims to have been mentioned by "Ovidius tertio de Vetula" is that described in pseudo-Ovid, *De vetula* III 611 sqq. (ed. D.M. Robathan, Amsterdam 1968).

12. For Māshā'allāh's doctrine see *The Astrological History*, pp. 48 and 99-100, and D. Pingree, *The Thousands of Abū Maʿshar*, London 1968, pp. 41-42 and 68-70. For Abū Maʿshar's adaptation of the Mighty Fardār to his own chronology see *ibid.*, pp. 60 and 66.

13. For Māshā'allāh see *The Astrological History*, pp. 48, 54, 56, and 99-100; for Abū Maʿshar's adaptation, see *The Thousands*, pp. 59 and 65.

14. See Y. Dold-Samplonius and H. Hermelink in *DSB*, vol. 7, New York 1973, pp. 82-83.

15. Nürnberg 1549.

16. *The Thousands*, p. 41 fn. 3; *DSB*, vol. 7, New York 1973, pp. 222-224.

17. E. g., H. Hermelink, "Tabulae Jahen", *AHES* 2 (1964), 108-112, esp. 110.

The "Liber Universus of ᶜUmar Ibn al-Farrukhān al-Ṭabarī"

DAVID PINGREE*

Though ᶜUmar was one of the leading astrologers of the early ᶜAbbāsid period[1], several of his most important works no longer survive in Arabic. One of these seems to be the *Kitāb fī al-mawālīd* in three books[2], of which a Latin translation is commonly ascribed to John of Seville[3].

This Latin translation was published five times in the sixteenth century[4]. It was first edited by Luca Gaurico[5], who added a separate treatise, the *De interrogationibus*, also attributed to ᶜUmar in the Latin[6], as a fourth book. The translation of the *De interrogationibus* by Salomon with the help of the Jew, the son of Abaumet (?), was completed, according to Gaurico's text : *currente anno ab incarnatione Christi* 1217, *Indictione* 5, *tertio die intrante Augusto, annis Arabum* 613 *et menses* 4 *annis* 14, *ultimo die mensis qui est Rabe secundus*. This text is obviously corrupt, but an approximate dating is possible. In 1216 (= 1217 current) A.D. 1 August fell on a Monday, not a Tuesday; and 14 Rabīᶜ II, 613 A. H. corresponds to 31 July 1216. The translation, therefore, must have been completed on 1 or 2 August 1216. But Salomon's translation of the *De interrogationibus* is not a part of the *De nativitatibus*. The latter work, by itself, was edited by Nicholas Pruckner[7]. His edition of the three books,

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1. M. Ullmann, *Die Natur-und Geheimwissenschaften im Islam*, Leiden 1972, pp. 306-307, and D. Pingree in *Dictionary of Scientific Biography* (henceforth *DSB*), vol. 13, New York 1976, pp. 538-539.

2. Its relation, if any, to the work on ff. 162v-172v of Nuruosmaniye 2951 (M. Krause, "Stambuler Handschriften islamischer Mathematiker," *QS* B 3 (1936), 437-532, esp. 445) remains to be investigated.

3. The earliest attribution is in a "catalogus librorum ab Arabis scriptorum quos forsan transtulerat Iohannes Hispalensis in Latinum" preserved in a thirteenth century manuscript and published by L. Thorndike, "John of Seville," *Speculum* 34(1959), 20-38, esp. 37-38. The forsan in the title of this catalogue emphasizes its lack of authority. Yet F.J. Carmody, *Arabic Astronomical and Astrological Sciences in Latin Translation*, Berkeley-Los Angeles 1956, pp. 38-39, even claims that the translation was made by John in 1127. The colophons in the manuscripts and printed editions that I have been able to check do not ascribe the translation of the *De nativitatibus* to John, but only that of the *Liber universus*.

4. The second edition listed by Carmody (Venice 1509) is not of the *De nativitatibus*, but of the *Liber novem iudicum* which contains many chapters on interrogations ascribed to ᶜUmar.

5. Venice 1503, 1515, and 1525.

6. But it includes a reference to Abū Maᶜshar, and therefore is at best an expanded version of a work of ᶜUmar.

7. Basel 1533 and 1551.

For the last two decades, my attention and intellectual inquisitiveness have been directed towards the bountiful history and philosophy of the Arabic-Islamic civilization. Precious treasures within this great heritage *(turāthī)* began to unfold upon studying the original manuscripts that survived and which constitute only a small fraction of the contributions of those bygone centuries. My research on the history of Arabic pharmacy and medicine has proved most worthwhile with still ample opportunities for many. The other fields of science and technology are most rewarding and inviting as well.

It is a surprising fact that numerous historians and scholars in the past and present have seen nothing that is worth their while in this civilization. And in their study of or writing on human cultures they pass directly from the Greco-Roman period to the European Renaissance as if nothing took place in the history of science and technology from the fall of Rome in the late fifth century to the fall of Constantinople in the fifteenth. They openly criticize the entire Arabic-Islamic period, avoiding facts and figures. Not knowing the language and its ramifications, this culture remains a closed chapter to them, a fact that in itself constitutes a barrier and a stumbling block. Many others, despite the evidence of new findings, prefer to stay in the dark as regards the true nature and extent of this civilization. They have no taste for "this foreign culture" and lack the desire or the initiative to investigate and discover it.[8]

This Journal:

For our part, in this journal, we shall endeavor to be fair and accommodating to all, to our supporters, but also to any who may who may lack enthusiasm for Arabic-Islamic accomplishments. We shall strive for the highest level of scholarship and accuracy.

Articles are welcome in English and French with Arabic summaries, and in Arabic with English summaries. Each essay or query will be reviewed by at least two editors or referees invited by the editors so as to secure first-class contributions. In addition to its appeal and high quality, we aim to make this Journal a ready and reliable reference to historians and scholars interested in Arabian and Islamic culture the world over.

As this new enterprise gets underway, new difficulties crop up daily. These we strive to surmount. Meanwhile we bespeak indulgence combined with constructive criticism from all. We anticipate, as time passes, a rapid and substantial increase in the number of subscribers and contributors.

We close this inaugural editorial with an expression of gratitude to the Board of Editors and to the Advisory Editors. Even more of their time will be called upon in the future if our journal is to grow and to prosper.

Washington, D.C. January, 1977 **Sami K. Hamarneh**

8. Claudius F. Mayer, "The Collection of Arabic Medical Literature in the Army Medical Library", *Bulletin of the Medical Library Association*, 30 (1942), pp. 96-99; Aldo Mieli et al., *La Science arabe et son rôle dans l'évolution scientifique mondiale*, Leiden, Brill, 1938, pp. 228-256; and Lynn Thorndike, "Latin Manuscripts of works by Rasis at the Bibliothèque Nationale, Paris", *Bulletin of the History of Medicine*, 32 (1958), 54-67, confirming the Arabic influence on educational institutions and circles in the Latin West.

inclusion of many nations with provincial tongues and dialects.[6] Hence let none be disturbed when we refer to Arabic. This was the *lingua franca* of science and technology, not to mention the other fields of learning, throughout the Islamic domain for several centuries. Add to this the fact that Arabic has a remarkable proficiency, clarity, elegance and facility to embrace and articulate all the developing scientific and technical knowledge, with a great potential for expansion. This language inevitably became a convenient medium, not only for the religious forms and ordinances of Islam, but for the needed unity, uniformity and direction of all aspects and expressions of intellectual and social life. As a result, most readers think of Muslims when Arabic is mentioned, and they associate the Islamic faith with the Arabian people. One can only conclude that those who argue this matter and make an issue of it are motivated by prejudice.

The following point, in this connection, also deserves mention. For the most part, the scientific and technical know-how that developed in medieval Islam was based on earlier cultures, significantly Indian, Persian and Greek.

All men of learning then held great respect and admiration for this heritage, realizing how their roots were nourished in Greek cultural soil. In their writings and utterances, they took every opportunity to acknowledge indebtedness, genuine appreciation and enthusiastic reverence. Arabian scholars and translators, such as Abū Zayd Ḥunayn b. Isḥāq al-ᶜIbādī (809-873) and his associates were careful to render their translation of the Greek writings as accurate as possible. But in the West the situation was not as commendable regarding the transmission of Arabic learning into Latin and the vernacular tongues. The translations were often inferior and defective. Furthermore, there was a lack of gratitude among the majority of the populace and within learned circles in the West. Many were even hostile and resentful of everything related to the Islamic civilization when they should have been grateful.[7]

Science Has No Boundaries:

Let us remember, what many Muslim scholars have already declared, that science and innovation know no national or religious boundaries. Knowledge is available to all who allow its bright awakening rays to touch their lives. Throughout the Islamic domain, however, it was the Arabic language that preserved the coherence, personality and originality of the nature and identity of this culture.

6. Donald Campbell, *Arabian Medicine*, Vol. 1, London; Paul, Trench, Trübner, 1926, pp. 118-162; and A. A. Khairallah, *Outline of Arabic Contributions to Medicine and the Allied Sciences*, Beirut, American Press, 1946, pp. 161-166.

7. Heinrich Schipperges, "Assimilationszentren arabischer Wissenschaft im 12. Jahrhundert", *Centaurus*, 4 (1956), 325-350; and *Die Assimilation der arabischen Medizin durch das lateinische Mittelalter*, Wiesbaden, Steiner. 1964.

In November of 1976, the new Institute was officially approved through a special decree by the President of the Syrian Arab Republic, Hafez al-Assad. Thereupon public and private financial contributions were collected to foster the activities and objectives of the Institute.[5]

Since its founding in April 1976, a resolution was enthusiastically adopted to undertake the publication of a periodical as an organ for the Institute and its cultural and educational mission. It was overwhelmingly endorsed by the participants of the Symposium, and by the University President, teaching staff, and friends. Its international board of editors will review and supervise its policy and objectives, and provide with other colleagues and arabists accepted critical and unbiased studies, bibliographical notes, and queries for publication in the journal. They will also encourage cooperative endeavors and investigations to utilize all available resources so as to increase and diffuse the knowledge of this culture among our readers around the world.

Why Called Arabic-Islamic?

Our efforts are focused on studies and investigations to rediscover and evaluate scientific and technical activities, most of which were carried out and recorded under Islamic patronage and aspiration. By and large, it was the Muslim rulers who sought scholars of various backgrounds and religious convictions, and encouraged and sponsored their intellectual pursuits and productivities. More than any other rulers of medieval times, they generously supported education and created interest and incentives in support of scientific activities and technical skills among all their subjects regardless of ethnic origins or religious affiliations. The vehicle of communication in learning, trade, politics and religion, however, was Arabic, the language of the Qurʾān, the holy book of Islam, revered and upheld as God's revelation and His word by all Muslims.

In this journal, it should be stated, there will be a conscientious attempt to avoid religious and political involvements, deliberations, debates or quibbles. This is an organ for researchers in scientific and technical matters and will treat the same objectives, rationally and with an open mind and heart. But we shall insist that our aim is strictly to appraise literary, archeological, scientific and technical contributions that were originally written mainly in Arabic, but also in Persian, Turkish or Urdu. Thus for a more flexible attitude and to respect both the language media as well as the civilization, it seems appropriate to use such terms as Arabic (Persian, Turkish or Urdu) – Islamic legacy for a more general application. Those who are invited to participate and contribute should necessarily and justly be qualified and knowledgeable in these languages and the culture that revolved around them. They should be able to examine and consult original sources for the purpose of evaluating their contents and contributions.

Arabic And Latin Compared:

For analogy we can look at the use of the Latin language in Europe from the Middle Ages up to the close of the Renaissance period. It was the language of teaching and of the learned throughout Western Europe. No one then or now, would ever have objected to naming it a Latin western culture, despite the

5. *Ibid.*, No. 3, November, 1976.

shadows of prejudice and misunderstanding for a long time.[2]

In the late eighteenth and nineteenth centuries several scholars, especially in Europe, became interested in the Arabic-Islamic culture. They began to uncover some of the Arabic writings hidden away in libraries, mosques and private depositories. In the present century, furthermore, the circles of researchers and investigators of this past have widened to include many more nations in the East and West, among whom are historians of science and technology of the Arab and Muslim world.

Stimulated by these new discoveries at about the middle of the nineteenth century, several periodicals and series of publications devoted to oriental studies began to appear. They carried important articles, and annotated first editions, thereby bringing to light these newly found treasures.[3] Soon other printing houses, as well, made it a point to publish these studies, and new oriental societies adopted and propagated such endeavors. To all of them, past and present, we acknowledge due recognition and gratitude.

Until now, however, there has never been a periodical solely devoted to the history of Arabic-Islamic science and technology. These fields, we believe, are of utmost significance for an understanding of the place of Arabic civilization in history, and for an appreciation of its contributions to the culture of mankind.

Founding of the Institute for the History of Arabic Science:

On the first day of the assembly of the "International Symposium for the History of Arabic Science" held at the University of Aleppo, April 5-12, 1976, the newly established Institute, (abbreviated IHAS) was inaugurated. The opening ceremonies at its headquarters in the University were attended by delegates from 20 countries together with Syrian officials and colleagues. One of the basic goals of the Symposium was to make known the Arabic scientific and technical heritage. This should be carried out through intensive, cooperative research and investigations of the original, primary sources by qualified scholars. Thereupon, an honest and accurate evaluation of this culture will be possible and fruitful.

Once the creative efforts of the medieval Arabic-Islamic civilization are understood clearly and objectively, they will serve as a challenging incentive both to succeeding generations of young Arabs, and to those interested in Islamic studies everywhere. It is hoped that they will continue this pioneering work with optimism and ingenuity. Their resourcefulness will help develop a progressive Arab society aided by strong scientific and technological incentives. This concept has been eloquently and precisely expressed by Dr. Ahmad Y. al-Hassan, President of the University and Director of the Institute.[4]

وذلك كي يصبح الكشف عن الماضي المجيد إنطلاقة نحو مستقبل مشرق .

2. See George Sarton, *Ancient Science and Modern Civilization*, New York, Harper Torch Books, 1959, pp. 51-83; also his *Introduction to the History of Science*, Baltimore, Carnegie Institute of Washington, 1927, pp. 543, 583-88, 619-24, 647-54, 693-99, and 738-47; and Max Meyerhof, "The Sources of the History of Arabian Medicine", *Ciba Symposium*, Vol. 6 (1944), pp. 1874-57; and "Equisse d'histoire de la pharmacologie et botanique chez les Musulman d'Espagne", *Al-Andalus*, 3, 1953, pp. 1-2.

3. For an annotated list of periodicals with a mention of major societies see S. Hamarneh, *Bibliography on Medicine and Pharmacy in Medieval Islam*, Stuttgart, 1964, pp. 179-189.

4. *I.H.A.S. Newsletter*, first year, No. 1, June 1976, University of Aleppo (Arabic), p. 3.

An Editorial

Arabic-Islamic Science and Technology

SAMI HAMARNEH

With this issue, an international periodical for the history and philosophy of Arabic-Islamic science and technology is launched. It is the first of its kind devoted entirely to these fields of knowledge.

The question may, however, be asked, why a new journal on the history of science when so many periodicals have ample space for the entire medieval period? What are its aims and objectives? And what are the resources that are available for such an undertaking?

To begin with, to most members of the editorial board as well as to our friends and supporters, this journal is a symbol and a fulfillment of a dream and an embodiment of a culture that is now undergoing a renaissance.

The Arabic-Islamic civilization rose and flourished in a time when classical civilizations had crumbled under the onset of barbarism, and when the shadows of ignorance had narrowed and darkened the hopes for enlightenment and prosperity during the early period of the Middle Ages. After the fall of the two great empires of Rome and Persia, the Arabic-Islamic domain spread eastward to the borders of India and westward throughout North Africa and the Iberian Peninsula.[1]

The hospitable Arabian spirit, and the tolerant Islamic faith soothed the wounds of nations and produced order out of chaos, and injected new life into dying old systems. The Arab-Muslim conquerors, fortunately, made good use of the cultures of the nations they subdued, a fact that awakened their creative talents. The end result was a revival of past learning, and continued, substantial improvements in cultural activities leading to remarkable levels of achievement. The light of learning, scholarship, innovation and industry burned brightly for centuries. Unfortunately, this was followed by decline and stagnation. The invaluable intellectual treasures of this important legacy, in the language of the Qur'an, were buried under the dust of ignorance and neglect and in the

1. Volumes have been written on the political and social history of the Arab civilization and the Caliphates. There are for example, a series of books on *al-Futūḥ* and *al-Maghāzī*; chronicles such as *Tarīkh al-Yaʿqūbī* and modern histories of the period by Jirjī Zaydān, Aḥmad Amīn, M. Enan and H. I. Ḥasan. See also Carl Brockelmann, *History of the Islamic Peoples*, tr. by M. Perlmann, New York, Putman, 1960, pp. 45-98; David M. Dunlop, *Arab Civilization*, London, Longman, 1971, pp. 17-25; John B. Glubb, *The Great Arab Conquests*, London, Prentice-Hall, 1964, pp. 139-255, 349-365; Anthony Nutting, *The Arabs*, New York, Potter, 1964, pp. 33-81; Philip K. Hitti, *History of the Arabs*, London, Macmillan, 1963 printing, pp. 139-168; William Muir, *The Caliphate, Its Rise, Decline and Fall*, Beirut, Khayats, 1963; pp. 60-185; and *Encyclopedia of Islam*, New edition, 1960 to present, see individual entries.

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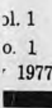
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